MINERALS

ECONOMIC & REGIONAL DEVELOPMENT AGREEMENT

CANADA–MANITOBA MINERAL DEVELOPMENT AGREEMENT

Sector A

Geoscientific Activities

Progress Report 1988·89

Canada

Manitoba

CANADA-MANITOBA MINERAL DEVELOPMENT AGREEMENT (MDA)

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Cover photographs: Top: Establishing a baseline (A); Middle: Data Processing (B); Lower: Fire assaying (C).

CANADA - MANITOBA

MINERAL DEVELOPMENT AGREEMENT

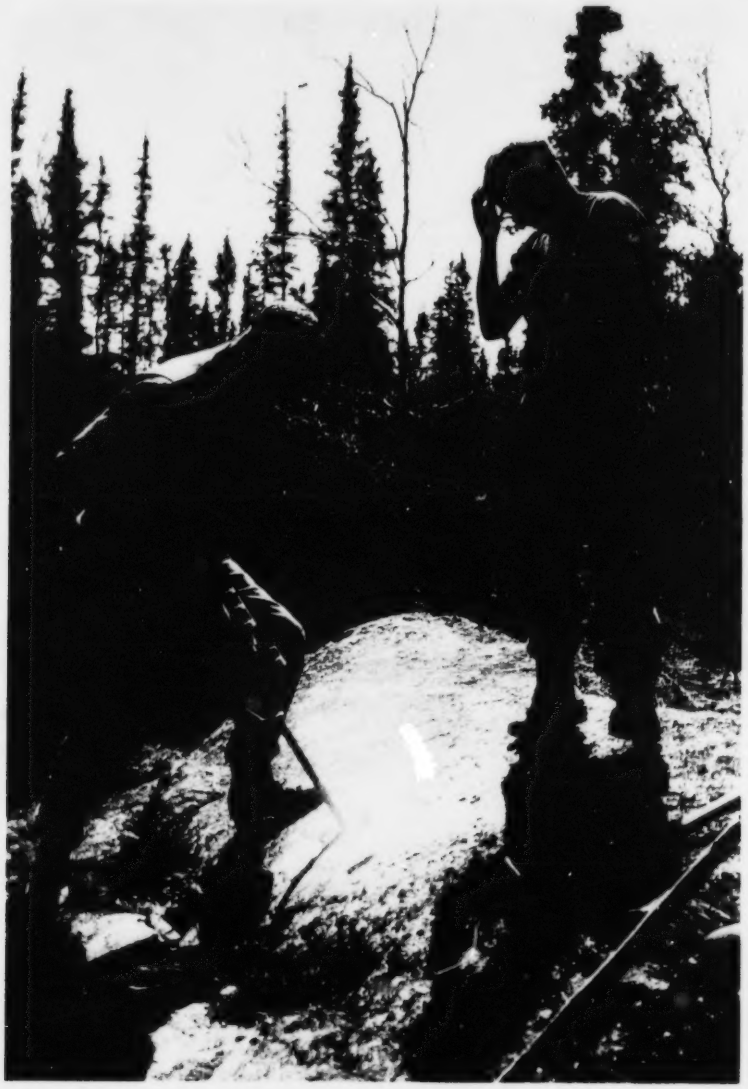
1984 - 89

SECTOR 'A' GEOSCIENTIFIC ACTIVITIES

PROGRESS REPORT 1988-89

Manitoba
Energy and Mines
Geological Services
Open File Report OF89-2

CANADA



Frontispiece: Extracting a sample for geochronological studies.

FORWARD

This is the fifth and final report in a series chronicling the achievements of the Provincial and Federal Geological Surveys in mounting cooperative programming under Sector 'A' of the Canada-Manitoba Mineral Development Agreement (MDA), a subsidiary agreement to the Economic and Regional Development Agreement (ERDA).

The report summarizes MDA-related geological investigations in Manitoba during the 12 month period ending March 31, 1989. It describes the rationale behind the work, the location and focus of activities, the agencies and individuals involved, and outputs that have been generated. As such the report constitutes an administratively-oriented supplement to technical reports and maps which are the principal product of the Surveys' work.

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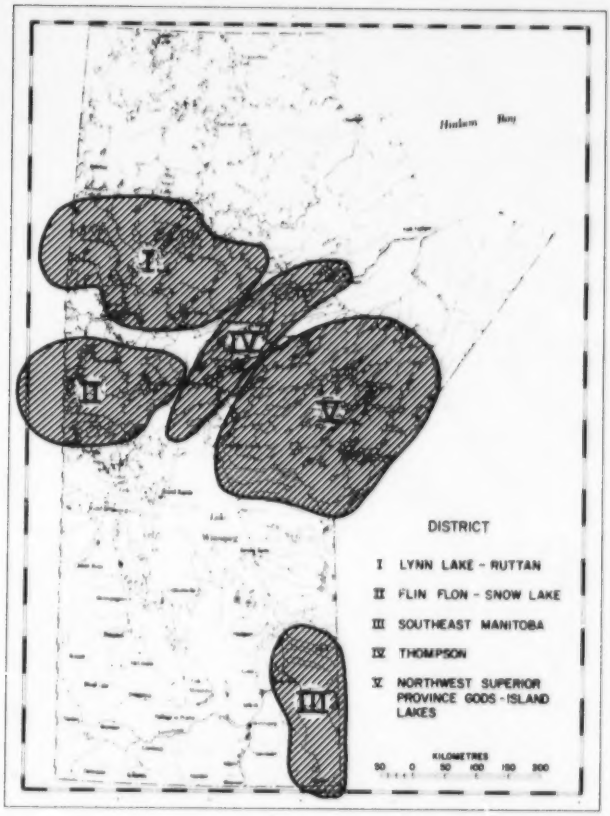

Figure 1a: Canada-Manitoba Mineral Development Agreement: Focus of 'Sector A' Geoscientific Activities.

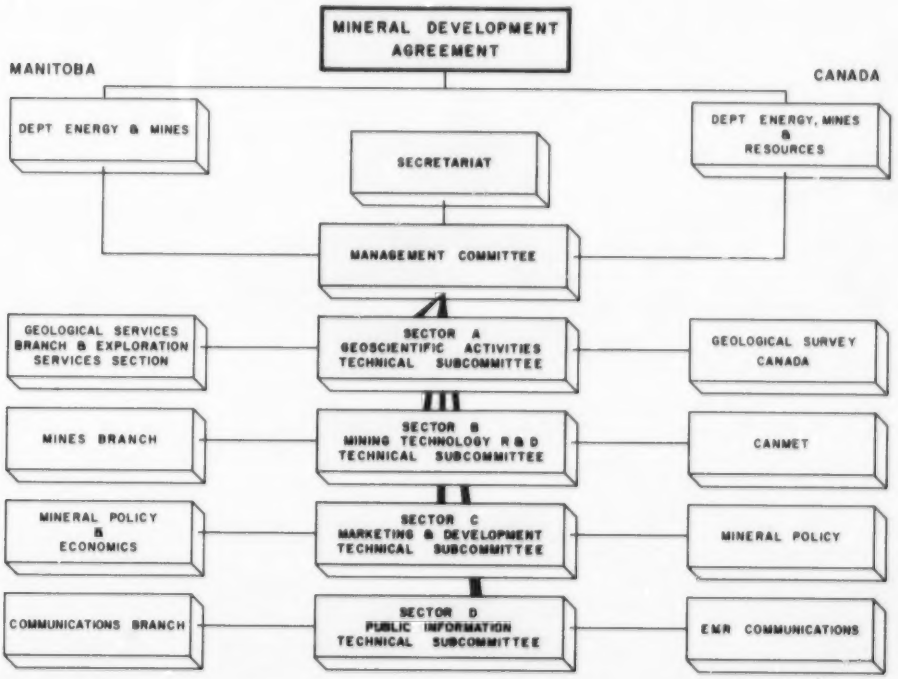

Figure 1b: Federal-Provincial liaison network and government agencies contributing to programming under the Canada-Manitoba Mineral Development Agreement (1984-1989).

I. CANADA-MANITOBA MINERAL DEVELOPMENT AGREEMENT 1984-89

BACKGROUND

The Canada-Manitoba Mineral Development Agreement is an important component in the Provincial and Federal governments' plan for stable and steady economic growth of the mineral industry in Manitoba. It also encompasses an all-embracing vision of Manitoba's future, a future in which the communities relying on the mineral industry will continue to grow and prosper.

On November 25, 1983 the Federal and Provincial cabinets approved both the 10 year umbrella Economic and Regional Development Agreement (ERDA) and the initial five year subsidiary Canada-Manitoba Mineral Development Agreement (MDA).

Under the MDA (1984-89) the Federal and Provincial governments agreed to contribute $14.8 million and $9.9 million, respectively for a total funding of $24.7 million.

The goals of the MDA are:

(a) to increase mineral exploration and the development of mineral resources in Manitoba, consistent with the broader joint planning underway through ERDA; (b) to assist in the more effective assessment and utilization of the province's mineral resources; and (c) to establish a framework for programs that will strengthen and diversify the mineral resource base of the provincial economy.

The MDA is designed to gather data, analyze, synthesize and disseminate information on the geology of Manitoba (with a special emphasis planned for the Lynn Lake/Ruttan and Flin Flon/Snow Lake districts) (Fig. 1a). It is also intended to coordinate research on mineral processing, metallurgical technology and mining methods, and to conduct marketing and other economic studies.

Work under the Agreement is grouped into four sectors (Table 1): 'A' - Geoscientific studies, 'B' - Mining and mineral technology R and D; 'C' - Development and Marketing studies; and 'D' - Public information, evaluation and administration.

Sector 'A' - Geoscientific activities (the subject of this Progress Report), are implemented by the Geological Survey of Canada (GSC) and the Manitoba Geological Services Branch (MGSB) together with research contributions contracted from universities.

Programs are organized into five categories: 1 - Precambrian Geological Investigations, 2 - Mineral Investigations, 3 - Geophysical Surveys, 4 - Geochemical Surveys, and 5 - Geological Compilations.

Workplans are developed each year by technical subcommittees (Fig. 1b) with industry input encouraged through a Mineral Exploration Liaison Committee (MELC) as well as through ongoing dialogue between government and industry geologists.

The original terms of the Agreement provided for a wrap-up year in which products stemming from the previous five years of research and investigations could be compiled and published. A description of the Workplan covering activities scheduled for 1989-90 is presented in the section following Outputs.

The joint Federal/Provincial Workplan for 1988-89 was approved by the Management Committee to the Agreement at its meeting in Ottawa, on March 3, 1988, and copies distributed to MELC representatives.

TABLE 1.

CANADA-MANITOBA MINERAL DEVELOPMENT AGREEMENT
SCHEDULE "B"
Summary of Costs 1984-89
($000,000's)

Sector/Program/Project	Federal Share	Provincial Share	Total Costs 5-Years
SECTOR A			
GEOSCIENTIFIC ACTIVITIES			
Program 1 Precambrian Geological Investigations			
— Detailed geological mapping, drilling		1 1	1 1
— Regional geological models, drilling	0 9		0 9
Program 2 Minerals Investigations			
— Detailed metallic and industrial minerals studies, applied research		2 05	2 05
— Mineral deposit models	1 25		1 25
Program 3 Geophysical Surveys	2 45		2 45
Program 4 Geochemical Surveys and Glacial Prospecting			
— Regional geochemical surveys	2 05		2 05
— Quaternary geology surveys	0 85		0 85
— Detailed environmental geochemistry and glacial prospecting		0 25	0 25
Program 5 Geological Compilation			
— Various compilation and information outputs		1 6	1 6
— Quaternary geology atlas, data systems	0 5		0 5
Subtotal Sector A	8 0	5 0	13 0
SECTOR B			
RESEARCH AND TECHNOLOGY			
Program 1 Mining Technology		75	75
2 Mine Safety and Productivity			
Project 2 1 Ground Control	1 32		1 32
2 2 Warning Systems	295		295
2 3 Exposure Index		295	295
Program 3 Processing Technology			
Project 3 1 SO_2 Reduction	2 180		2 180
3 2 Milling Research	470		470
3 3 Tailings Research		1 10	1 10
3 4 Industrial Minerals	4	62	1 02
Subtotal Sector B	4 665	2 765	7 43
SECTOR C			
DEVELOPMENT STUDIES	885	885	1 77
SECTOR D			
PUBLIC INFORMATION, etc.	1 25	1 25	2 5
TOTAL	14 80	9 9	24 70

TABLE 2.

Sector 'A' Workplan 1988/89 Expenditures by program; Geological Survey of Canada (GSC) and Manitoba Geological Services Branch (MGSB)

PROGRAM	GSC* ($000)	MGSB** ($000)
1 Precambrian Mapping	129.3	209.5
2 Minerals Investigations	238.0	364.3
3 Geophysical Surveys	374.8	-
4 Geochemical Surveys/ Basal Till	250.6	36.0
5 Compilations	83.1	124.5
6 Overhead including Capital	43.5	-
TOTAL	1119.3	734.3

*February 27, 1989

**April 19, 1989

SECTOR 'A'

PROGRESS REPORT

1988/89

Figure 2: Field tour in the Thompson open pit.

Figure 3: Atomic absorption spectroscopy at Logan Avenue Analytical Laboratory.

Figure 4: Preparing the final geological map, Cartographic Services section.

II. SECTOR A GEOSCIENTIFIC ACTIVITIES PROGRESS REPORT
REVIEW OF ACTIVITIES 1988/89

Introduction:

In 1988 the main thrust of Federal and Provincial Sector 'A' Geoscientific Activities has been to conclude and document all investigations mounted over the previous four year term of the Canada-Manitoba Mineral Development Agreement (MDA).

The joint Federal/Provincial Workplan for Sector 'A' Geoscientific Activities was approved in March, 1988, and copies distributed to members of Manitoba's Mineral Exploration Liaison Committee (MELC). Briefing sessions outlining program objectives and field crew locations, were held in Winnipeg and several northern mining districts prior to the field season. A joint Federal/Provincial Sector 'A' Progress Report for 1987-88 was released June 27, 1988.

Manitoba Geological Services Branch (MGSB):

Forty-six Provincial projects were active during the year, including 21 geological mapping, 21 minerals investigations, 3 compilation studies and 1 basal till investigation. Twenty-four projects entailed field work, the balance being directed towards sample and data analysis, and report production. A modest level of field investigations was maintained in all mining districts with an operational budget of $744.5K. Twenty-five university students were hired in support of the summer field program.

Provincial cooperation with the University of Manitoba was limited to three applied geoscience research projects, namely the rare element pegmatite investigation conducted by P. Cerny, and two petrological projects in the Flin Flon and Thompson regions by N.M. Halden.

MGSB work continued on several maps in the synoptic 1:250 000 scale bedrock compilation series. NTS sheets 63N - Kississing Lake, 64H - Northern Indian Lake and 54E - Herchmer were released in November, whilst 63O - Nelson House was prepared in draft form. Production of 53M was postponed in favour of other higher priority areas.

Throughout the summer, MGSB staff led numerous field tours in the northern mining districts for the benefit of industry and other government geologists.

Displays and field tours of Manitoba's Paleozoic formations were provided in support of the American Association of Petroleum Geologists regional meeting in Bismarck, North Dakota, and an outline of the Province's basal till programs was presented at the September 29, 1988, Minnesota Geological Survey Open House in Hibbing, Minnesota.

The results of the 1988 field program were summarized in talks given by staff of the MGSB, GSC, and Department of Earth Sciences, University of Manitoba, at the Mineral Resources Division's annual Meeting with Industry, held at the Winnipeg Convention Centre, November 21 and 22, 1988 (313 delegates).

Numerous publications, pamphlets and brochures were released at the meeting including the Division's Report of Field Activities, 16 preliminary geological maps, three synoptic compilations and an updated bibliography of geological reports dealing with the Province. Following the format developed in 1987, the Provincial Report of Field Activities was expanded to include abstracts and summaries of work undertaken by the GSC as the Federal contribution to the MDA.

Forty-eight displays were exhibited at the Meeting with Industry, and industry participation initiated through a MINI-CORESHACK in which key sections of drill core from new discoveries were made available for examination.

During the winter months, several talks were given by Provincial and Federal geologists at symposia across Canada, at branch meetings of the CIM in northern Manitoba, and at the March, 1989 annual convention of the Prospectors & Developers Association of Canada (PDAC) - Toronto (4,100 delegates).

MDA outputs were also displayed at the PDAC as well as at the GSC Forum in Ottawa (January 17 and 18, 1989).

In the Spring of 1989 efforts were principally directed toward analysis of field data and preparation of reports and maps. Numerous technical publications were completed, and released at intervals throughout the year.

From September 1988 to March 1989 MGSB staff responded to over 455 enquiries on minerals-related topics, in addition to numerous exchanges at the annual Meeting with Industry and 151 requests for specific information received at the annual PDAC convention. During the year the Exploration Services Section of the Mines Branch responded to 751 general enquiries, 296 of which required in-depth follow-up.

MGSB staff also provided extensive support to other sectors of MDA including development of educational publications, installation of granite curbing in the City of Winnipeg, provision of raw materials (silica sand, chromite, etc.) for laboratory testing, technical input to land-use development plans and negotiations, and evaluations of private sector exploration proposals.

This year MGSB undertook a review of its data bases and data-handling systems, partially in the context of a broader provincial initiative (LINNET) to establish an integrated Geographic Information System in Manitoba, but also in response to a resurgence of interest in computer-oriented data (minerals) processing across Canada. Several personal computers and word processing/desk-top-publishing units were acquired in the Spring of 1989 as the first step toward improving the Branch's data processing and report production capabilities.

Figure 5: The hazards of winter drilling; Mawdesley Lake near The Pas.

Figure 6: Provincial and Federal geologists (Doug Fogwill and Al Galley) examining the Chisel Lake orebody. Cooperative mapping program by Al Galley (GSC) and Alan Bailes (MGSB).

Analytical Laboratory:

The Provincial analytical laboratory at Logan Avenue, provided 3,114 assay determinations and 15,525 silicate analyses. The geochemistry section provided 22,548 geochemical determinations, and over 70,000 element determinations were completed through commercial laboratories in support of MDA geochemical surveys in northern Manitoba.

Rock Preparation Laboratory:

During the year ending March 31, 1989, the Rock Preparation Laboratory completed 2,845 thin sections, 612 stained slabs and 12 polished slabs. The laboratory also prepared 1,896 samples for chemical analysis.

The Rock Preparation Laboratory maintained a Precambrian rock and two petroleum core warehouses. Support was also provided to 30 requests from the petroleum industry to review core.

The Rock Preparation Laboratory was also involved in a summer drilling program in which 14 holes were drilled for a total of 1160.8 metres. Of these, 12 were for stratigraphic interpretation and 2 to assist mapping of the Precambrian basement in the Project Cormorant area south of Flin Flon.

Editorial and Cartographic Services:

Editorial and Cartographic Services supply advisory and technical support in all phases of the preparation of geological reports for the Geological Services and Mines Branches, and for the Petroleum Division. The various reports published or in press during the fiscal year ending March 31, 1989, are listed in the section on OUTPUTS.

Oxford House NTS 53L, Herchmer NTS 54E and Northern Indian Lake NTS 64H (1:250 000) map sheets contribute additions to the Bedrock Compilation series. Mineral Deposit Series Reports Nos. 1, 2 and 3 are part of a series of 28 reports that give detailed documentation of mineral deposits and occurrences in the Lynn Lake, Leaf Rapids, Flin Flon, Snow Lake and Bissett regions. Contributions to the 1:250 000 Aggregate Resource Compilation Series include Kenora NTS 52E, Winnipeg NTS 62H and Pointe du Bois NTS 52L. The Report of Field Activites, 1988, contained 52 papers on various aspects of the geology and mineral resources of Manitoba.

In addition, visual aids, displays and other materials were prepared for presentations by staff members at meetings in Manitoba, other provinces in Canada and in the United States.

Geological Survey of Canada:

The 1988-89 fiscal year was the fifth and final year of the 1984-89 Canada-Manitoba Mineral Development Agreement. For many of the GSC projects officers involved in the MDA, the 1989-90 fiscal year will be used in report preparation so that the data collected over the past five years, with subsequent analysis and interpretation, will be appropriately documented. In order to speed up the publication of results, most project officers will prepare GSC open file reports to be made available to the public by the fall of 1989. Final reports will follow by March, 1990.

Future Federal/Provincial Programming:

Discussions with officials of EMR Canada continued to refine a five year workplan that could be initiated as a successor to the current MDA. Modelled in large part on the initiatives delivered during the 1984-89 period, these exploration-supportive geological, geophysical and geochemical investigations incorporate numerous suggestions tabled by industry geologists.

In March, 1989, the Program Evaluation Branch of EMR Canada solicited proposals for an evaluation of the MDA's in Saskatchewan, Manitoba, New Brunswick, Nova Scotia and Newfoundland. The evaluation is to be initiated April 1, 1989 with instructions to report on the effectiveness of the MDAs, by Province and collectively, as a mechanism for delivering cooperative Federal/Provincial minerals programming.

In this context, it is to be noted that the mineral industry has been particularly vocal over the last two years in supporting the MDA's as a cost effective, timely, and well focussed approach to providing government technical aid to mineral exploration and regional economic development. Presentations by the PDAC and MAC at the 1988 Mines Ministers' conference in Quebec both advocated renewal of the MDA's for a second five year term. This sentiment was repeated frequently in Trade journals, and at major conventions, and most recently (March, 1989) in letters to the Federal Ministers of Energy Mines and Resources, Finance, and Western Diversification Office from companies across Canada, as well as the provincial and national PDA and Mining Associations.

In addition to lobbying for renewal of the agreements, industry has indicated a willingness to join both levels of government in financially supporting selected components of the proposed program delivery, as well as continuing to provide advisory input through the Mineral Liaison Committees that have now been established in all Provinces across Canada.

W.D. McRitchie (MGSB)
A.G. Galley (GSC)

April, 1989

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* MGSB - Manitoba Geological Services Branch
GSC - Geological Survey of Canada
MAC - Mining Association of Canada

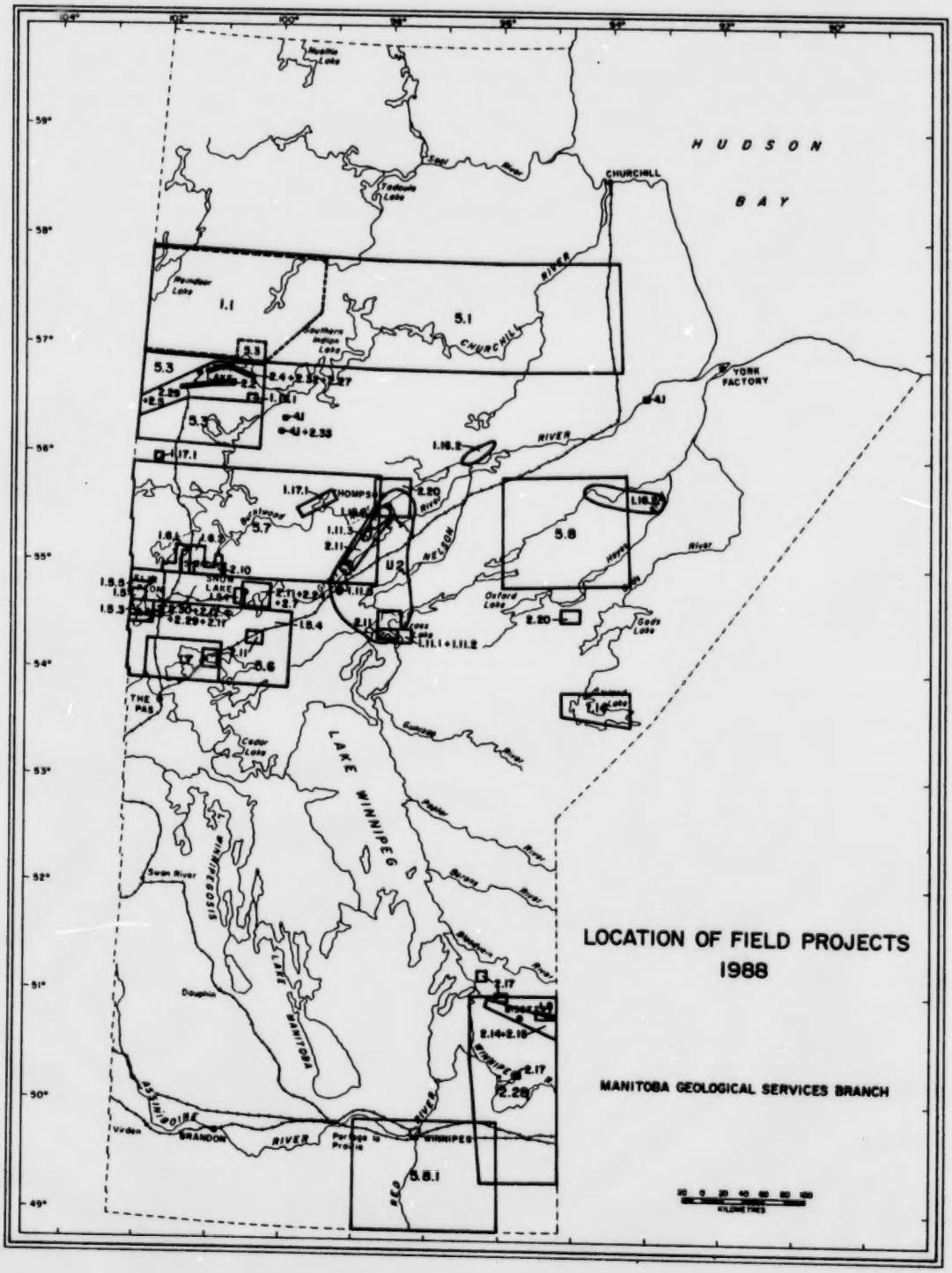


Figure 7: Location of Provincial Projects 1988/89.

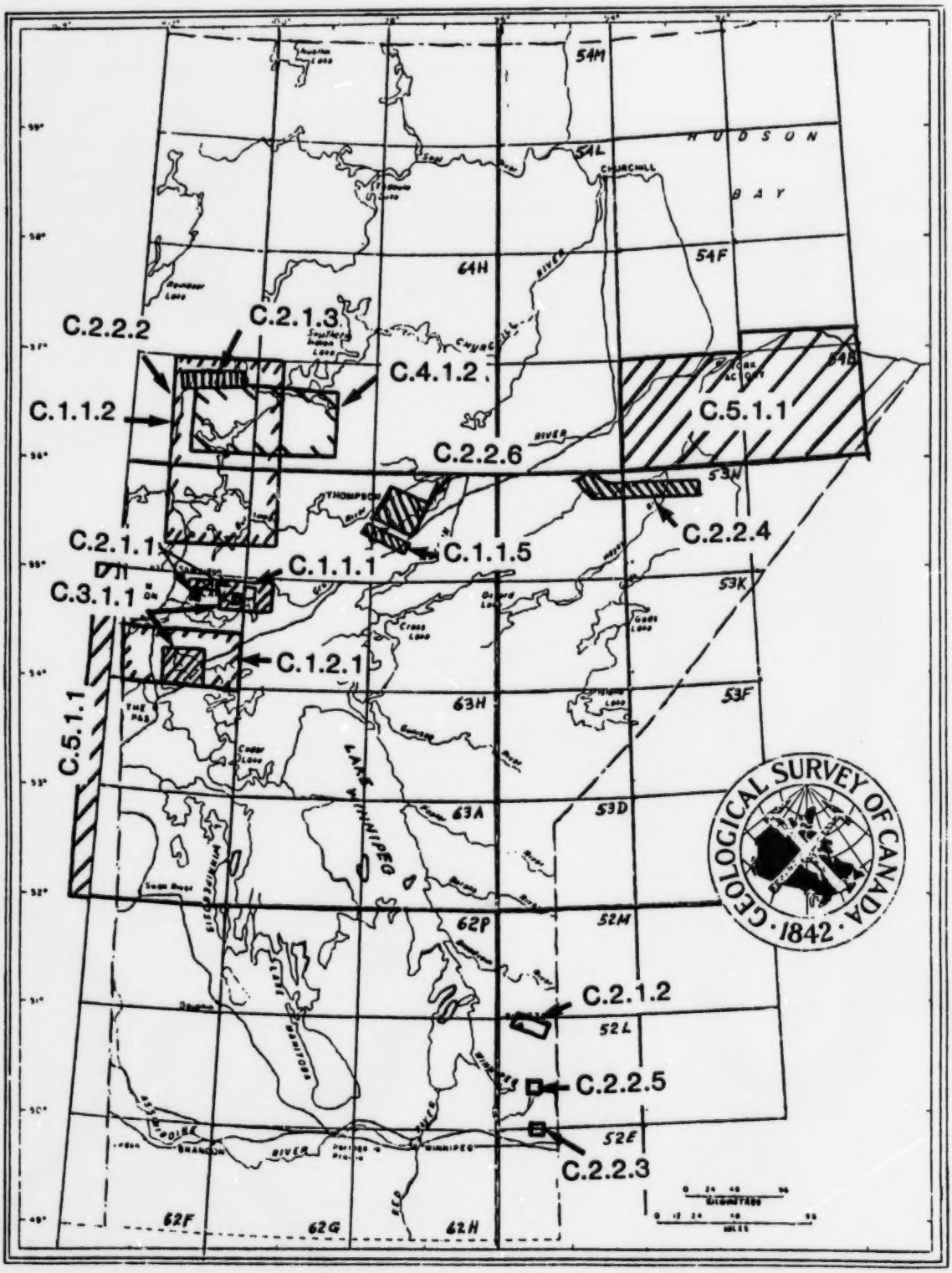
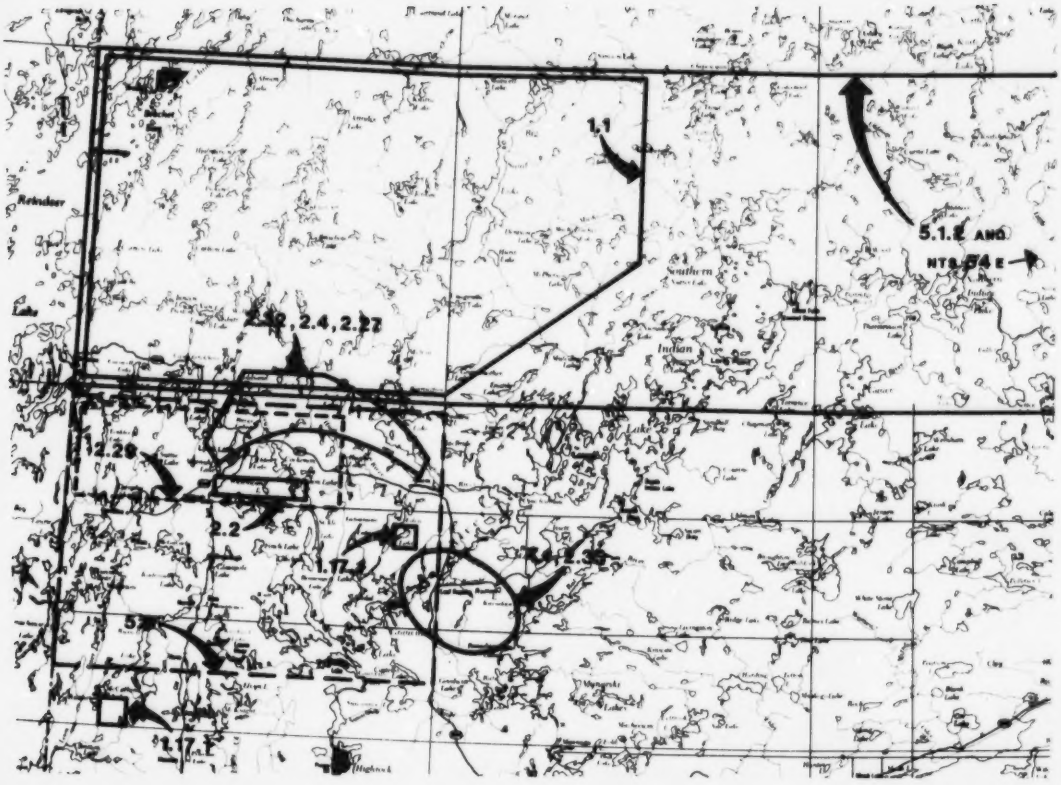


Figure 8: Location of Geological Survey of Canada field projects 1988/89.



DISTRICT I: LYNN LAKE - RUTTAN

1.1: Geological mapping, Brochet-Big Sand Lake (Report production)
2.2: Gold deposits, Johnson Shear
2.4: Rock geochemistry, biogeochemistry and stratigraphy of the Agassiz Metallotect
2.5: Industrial minerals evaluation, Lynn Lake area
2.29: Mineral deposit documentation, Lynn Lake
2.32: Iron Formations in the Lynn Lake area
2.33: Mineral deposits documentation, Ruttan Lake area
4.1: Basal till investigations, Lynn Lake -Leaf Rapids area
5.1 2: Northern Churchill Synoptic geological compilation
5.3: Lynn Lake report and maps

Figure 9: Provincial Sector 'A' projects 1988 - District I: Lynn Lake-Ruttan.

III. PROJECT REPORTS
DISTRICT I: LYNN LAKE-RUTTAN (including northern Churchill Province)

SUMMARY:

MANITOBA GEOLOGICAL SERVICES BRANCH:

Geological mapping at 1:5000 and geological sampling along the Agassiz Metallotect continued this field season. High-Mg volcanic rocks, a major component of the rocks within the Metallotect, were located at Arbour Lake, White Owl Lake and Barrington Lake.

In the Barrington Lake area the stratigraphy is consistent for approximately 5 km and is broadly similar to the stratigraphy of the Eagle Lake area mapped in 1987.

Several mineral occurrences were examined in the Arbour Lake area. Banded magnetite iron formations were mapped and sampled near Jim Lake and Muskeg Lake.

Till sampling in the Darrol Lake area south of Ruttan Mine revealed mainly background geochemical values and abraded gold grains interpreted to have been derived from extensive glacial erosion of volcanic and sedimentary rocks up-ice. Results from the Deep South Bay and Duval Lake area were similar but do not rule out the potential for gold mineralization up-ice towards the Kisseynew gneiss belt.

Vegetation geochemical studies are proceeding in the Dot Lake area, and the results of the Farley Lake remote sensing study were released as a joint GSC/MGSB Open File report.

Aegirine-augite and augite-bearing miaskitic alkaline intrusions at Eden and Brezden Lakes were sampled and analyzed confirming the similarity of these bodies with that mapped at Burntwood Lake last year. Evidence of associated economic mineralization is not yet apparent. However, repeat analyses from a xenolith collected from the northeast shoulder of the intrusion yielded, 14 000 ppm cerium, 10 000 ppm lanthanum, 6 000 ppm neodymium and 1 500 ppm samarium. Further sampling of this region is scheduled for the 1989 field season.

Private sector exploration activity in the Lynn Lake region continued to focus on gold properties, most of which were surveyed and sampled by MDA personnel in previous years. Further north, MDA basal till studies and GSC regional geochemical work prompted immediate follow-up by W. Bruce Dunlop Ltd., and Falconbridge/Kidd Creek in the Seal River area, as well as continued efforts by Continental Gold, Pacific Sentinel Gold and Homestake Mineral Development Co. on targets defined by earlier government mapping and geochemical surveys.

GEOLOGICAL SURVEY OF CANADA:

The Geological Survey of Canada completed projects in the Lynn Lake-Rusty Lake region. An airborne EM survey was completed in the region to the west of Lynn Lake, the results published in February, 1989. Also in the Lynn Lake region, a study was completed under contract to the University of Manitoba evaluating the use of remotely sensed biogeochemical data, in conjunction with airborne geophysics and LANDSAT, in detecting areas of high precious and base metal potential. Detailed geochemical lake sediment and water surveys and interpretative studies were completed along the south flank of the Lynn Lake Belt, with the results increasing our knowledge as to the mobility of metal ions in various samples media, and pinpointing some areas for both base metal and precious metal mineralization. Detailed drift prospecting programs were completed in the Darrol Lake (Rusty Lake Belt) and Wheatcroft Lake regions, the latter being part of an M.Sc. thesis to be finished by early summer.

PROJECT DESCRIPTIONS

MANITOBA GEOLOGICAL SERVICES BRANCH

PROJECT 1.1: Geological mapping, Big Sand-Brochet area

INVESTIGATOR: D.C.P. Schledewitz

OBJECTIVES:

To provide updated and more detailed maps and a comprehensive report on NTS areas 64F and 64G to assist mineral exploration and evaluation of regional geochemical data.

PROGRESS:

Final report is being prepared and will be completed in 1989/90.

PRODUCTS:

Two compilation maps with marginal notes, 64F and 64G, were prepared for the Branch's Bedrock Compilation Series. A paper discussing the geochemical and isotopic data co-authored with N.M. Halden, and G.S. Clark (University of Manitoba), and P.G. Lenton and M.T. Corkery (Manitoba Energy and Mines) has been submitted to GAC, for incorporation in a Special Paper on the Trans-Hudson Orogen.

FOLLOW-UP AND IMPLICATIONS:

A zone of mineralization outlined by mapping in the Le Clair Lake area was examined by subsequent basal till sampling program. Final report with maps 64F, 64G at 1:250 000 and selected areas at 1:50 000 in 1989/90.

PROJECT 1.1.1: U-Pb zircon geochronology - Lynn Lake region (R.V.S.)

INVESTIGATORS: R. Van Schmus (University of Kansas), D.C.P. Schledewitz

OBJECTIVES:

To provide precise age determinations of major plutonic rock units in the Lynn Lake, Southern Indian Lake and Chipewyan districts.

PROGRESS:

Refinement of preliminary U-Pb zircon ages previously reported and completion of analytical work, as yet unpublished.

PRODUCTS:

Isotopic ages were used in compilation maps for NTS areas 64F and 64G, to be printed in 1989.

FOLLOW-UP AND IMPLICATIONS:

Publication of data and interpretations in a scientific journal.

PROJECT 1.2: Uranium-lead isotope investigations, Southern Churchill Province

INVESTIGATORS: E.C. Syme and A.H. Bailes;
T.M. Gordon (GSC)

OBJECTIVES:

To determine, by U-Pb isotope analysis, the ages of selected rock units in the Lynn Lake and Flin Flon regions. Accurate ages of volcanic and intrusive rock units make up an essential part of the geological data base, and indirectly date the formation of enclosed base and precious metal deposits.

PROGRESS:

Five samples from the Flin Flon-Snow Lake-Athapapuskow Lake area were collected for analyses in 1989/90.

PRODUCTS:

1. Report in 1988 Manitoba Report of Field Activities.

2. Scientific paper co-authored by Gordon, T.M., Hunt, P.A., Bailes, A.H. and Syme, E.C.; "U-Pb ages from the Flin Flon and Kisseynew belts, Manitoba: Chronology of crust formation of an Early Proterozoic accretionary margin", submitted to GAC for incorporation in Special Paper on the Trans-Hudson Orogen.

FOLLOW-UP AND IMPLICATIONS:

In 1989/90 further analytical work will be conducted in the region. These follow-up studies will refine the timing of magmatic and deformational events and their relationship to mineralization; e.g. the age of late alkaline magmatism and its relation to Au mineralization.

PROJECT 1.3/1.16: Rubidium-strontium geochronology in Manitoba

INVESTIGATOR: G.S. Clark, University of Manitoba

OBJECTIVES:

This is a continuation of work initiated in 197? to determine Rb-Sr ages from lithotectonic domains of the Churchill and Superior structural provinces in northern Manitoba. The establishment of a geochronological framework is an essential supplement to field mapping for constructing models of crustal evolution within the various domains and the relationship of the domains to one another, in order to identify the most favourable targets for future exploration programs.

This project will concentrate on rocks not dateable by the U-Pb method.

PROGRESS:

Analytical work completed in 1988.

PRODUCTS:

-Scientific paper, co-authored with D.C.P.Schiedewitz, published 1988 in Canadian Journal of Earth Sciences (see OUTPUTS).

-Scientific paper, co-authored with N.M. Halden, et al., in press; in GAC-MAC Special Paper on Trans-Hudson Orogen (see Section IV, OUTPUTS).

FOLLOW-UP AND IMPLICATIONS:

Isotopic data will be integrated with other studies (geochemical, structural, U-Pb geochronology: see Projects 1.16.2, 1.11.3, C.1.1.4, C.1.1.5, C.2.2.6). Whole rock Pb isochrons and Sm-Nd studies are planned.

PROJECT 1.17.1: Churchill Province alkaline intrusions

INVESTIGATOR: W.D. McRitchie

OBJECTIVES:

To initiate systematic detailed mapping and sampling of alkaline intrusions in the Churchill Province to determine the levels and potential to contain rare element minerals such as zirconium, yttrium, niobium, etc. as well as phosphates. The initial stage of this work will entail a detailed evaluation of all literature to determine the intrusions in Manitoba that warrant re-investigation.

PROGRESS:

Aegirine-augite and augite bearing alkaline monzonite/syenite intrusions at Eden and Brezden lakes were sampled and mapped. Seventeen major and trace element analyses confirmed a miaskitic chemistry similar to that of the Burntwood Lake syenite mapped in 1987. One sample of a mafic, possibly xenolithic, phase from the Eden Lake intrusion exhibits high REE concentrations, specifically in yttrium, lanthanum, and cerium.

Re-analysis of the sample with high REE provided 14000 ppm Cerium, 10000 ppm Lanthanum and 6000 ppm Nd. Representative modal analyses have been undertaken for the Brezden and Eden Lake intrusions.

PRODUCTS:

Progress report in Report of Field Activities 1988.

FOLLOW-UP AND IMPLICATIONS:

Sector of the Eden Lake intrusion with elevated REE has been targetted for follow-up detailed mapping.

PROJECT 2.2: Gold deposits, Johnson Shear

INVESTIGATOR: D.A. Baldwin

OBJECTIVES:

To establish the controls for gold mineralization along the Johnson Shear Zone.

PROGRESS:

Initial geological field investigations on the shear zone have been completed. Field data have been collated and portrayed on geological maps and stratigraphic sections. Subsurface data collected from diamond drill core have been incorporated in diagrams displaying stratigraphy and patterns of alteration. Geochemical data on host rocks to mineralization, and on the mineralization, were obtained during previous field season. During the 1988 field season an M.Sc. thesis study was initiated at Gemmel Lake area. This work confirms that gold mineralization can be traced along the length of the Johnson Shear structure for more than 50 km.

PRODUCTS:

Report GS-3 in Report of Field Activities 1988. Mineral Deposit Series map and report for NTS area 64C/14 is completed and that for NTS area 64C/15 is in preparation.

FOLLOW-UP AND IMPLICATIONS

The Johnson Shear Zone has been established as a major metallogenic feature in the Lynn Lake area that will warrant follow-up detailed studies and exploration. Mineral Deposit Series reports and maps for the remaining four NTS map areas will be completed by March 1990.

PROJECT 2.4: Rock geochemistry, biogeochemistry and stratigraphy of the Agassiz Metallotect

INVESTIGATOR: M.A.F. Fedikow

OBJECTIVES:

To examine the feasibility of using detailed and regional biogeochemical surveys to establish mineral exploration targets in the Lynn Lake area.

To determine whether the trace element content of peat bogs can be used as an indicator to locate "blind" gold mineralization along the Agassiz Metallotect.

PROGRESS:

A total of 232 black spruce twig samples, from the Dot Lake survey remain to be ashed and analyzed. An economic geology report describing rock geochemical alteration studies at the MacLellan Au-Ag deposit is near completion. An M.Sc. thesis by Joel Gagnon at the University of Windsor (Ontario) describing alteration features at the MacLellan deposit is near completion.

PRODUCTS:

The results of this project have been released as Open File reports, publications in referred journals, poster displays and oral presentations.

Gagnon, J., 1988: Progress report - MacLellan Au-Ag deposit alteration study; University of Windsor, Windsor, Ontario, 4 p.

Fedikow, M.A.F., Parbery, D. and Ferreira, K.J., 1989: Geochemical target selection along the Agassiz Metallotect utilizing stepwise discriminant function analysis; Canadian Institute of Mining and Metallurgy Symposium "Hydrothermal Alteration - How Good A Guide To Mineralization", Quebec City, May (Oral presentation and abstract).

Fedikow, M.A.F., Parbery, D. and Ferreira, K.J., 1989: The Agassiz Metallotect - A regional metallogenetic concept for the Lynn Lake area; Mineral Deposit Map Series, 1:50 000 compilation map with marginal note. (In preparation)

Fedikow, M.A.F., 1989: Rock geochemical alteration studies at MacLellan Au-Ag deposit, Lynn Lake, Manitoba Mineral Resources Division, Economic Geology Report (in prep.).

FOLLOW-UP AND IMPLICATIONS:

Recent discoveries of gold mineralization (Farley Lake, Dot Lake) along the Agassiz Metallotect, in addition to the MacLellan Mine, indicate high potential in these rocks for repetitions of MacLellan-type or other styles of gold mineralization. Stratigraphic and geochemical studies are continuing along the entire metallotect in an attempt to identify more localized zones of higher gold potential.

The delineation of 70 km of highly prospective gold and base metal environments has been recognized in the northern belt of the Lynn Lake greenstone belt. A sequence of picrite basalt has been overprinted by a zone of structural disruption along the observed 70+ km of the metallotect extent. Numerous zones of Au+, Ag and base metal mineralization occur in the metallotect, i.e. the MacLellan Main Zone (998,000 tonnes grading 6.51 g/t Au and 8.89 g/t Ag), the Nisku deposit (187,000 tonnes grading 6.51 g/t Au, 1.3% Zn and 0.8% Pb), the Rainbow deposit (593,000 tonnes grading 8.57 g/t Au), the Dot Lake deposit (1,248,000 tonnes grading 4.01 g/t Au), and the Farley Lake deposits (Wendy Zone and East Zone; 1,300,000 tonnes grading 6.86 g/t Au and the South Zone; 363,000 tonnes grading 4.80 g/t Au). The recognition of the regional extent of the depositional environment for these deposits and the tremendous residual exploration potential offered by this metallotect was not recognized prior to 1983 when this project commenced. Accordingly, project 2.4 has effectively established the Agassiz metallotect in the northern belt of the Lynn Lake greenstone belt as a prime gold and base metal exploration territory.

PROJECT 2.5: Industrial minerals evaluation, Lynn Lake area

INVESTIGATOR: W.R. Gunter

OBJECTIVES:

To evaluate reported occurrences of building stone and other industrial minerals in the Lynn Lake/Leaf Rapids/Thompson area. The deposits will be sampled to determine the suitability of the material for industrial mineral use. Detailed mapping and sampling will be conducted on those deposits considered to be geologically favourable.

PROGRESS:

No field work was undertaken during 1988 since field investigations of selected mineral occurrences in the Lynn Lake area was completed in previous years of this project. Minor field work was undertaken in the Thompson area and Red Sucker Lake area as parts of Project 2.11. Occurrences documented include; metamorphosed alteration zones in the Fox Mine area near Lynn Lake and at the Ruttan Mine; cordierite occurrence near Nelson House; marble and granite occurrences at the Manasan Quarry and the Pipe Lake Mine; quartzite occurrences at the Manasan Quarry; and, a serpentine occurrece at the Pipe Lake Mine. Petrological studies, detailed mapping, drilling and test polishing of samples from the granite and marble occurrences outline exploration by private sector companies towards diversification from base metals into industrial minerals, as well as, to improve the geological database for northern Manitoba by providing an inventory of major industrial mineral occurrences.

PRODUCTS:

A final report on "Industrial Minerals Potential in northern Manitoba" will contain separate chapters on industrial minerals in the Lynn Lake and Thompson areas. This report will be in first draft status by mid-to-late April 1989. Public lectures were presented to prospectors and exploration geologists at Lynn Lake in February, 1989.

FOLLOW-UP AND IMPLICATIONS:

High potential industrial mineral sites have been documented in northern Manitoba.

PROJECT 2.27: Remote sensing - Agassiz Metallotect

INVESTIGATORS: M.A.F. Fedikow, W. Moon and V. Singh (University of Manitoba)

OBJECTIVES:

To identify mineralization buried beneath glaciolacustrine deposits. Remote sensing techniques, using MEIS II and MSS spectral scanners, will determine whether airborne detection of vegetation stress can be used to identify buried precious and/or base metal mineralization. The entire region underlain by the Agassiz Metallotect is to be investigated.

PROGRESS:

As part of the Agassiz Metallotect Remote Sensing project detailed bedrock geology, surficial geology, vegetation distribution, INPUT electromagnetic data, and vertical field gradiometer data are currently being digitized. A detailed remote sensing study undertaken in the Farley Lake area of the Agassiz Metallotect, utilizing MEIS II and MSS remotely sensed data and the available geological and geochemical data base, has been completed. The results have been released jointly in GSC OF 1994 and in MGSB, Open File Report OF88-3: these results will form the basis for a paper to be presented at the upcoming Vancouver and Calgary Remote Sensing Conferences. Since fiducial points for airborne gradiometer results in the Farley Lake area were unavailable at the time of the remote sensing study the gradiometer results were not integrated with the existing data base. Recent acquisition of this information has permitted the principal investigators at the University of Manitoba to integrate the gradiometer data with the data base at hand and to re-integrate the results from Farley Lake. The re-evaluation is being undertaken without MDA funding. The regional scale MEIS II and MSS remote sensing project of the Agassiz Metallotect will proceed independant of a second Mineral Development Agreement. These data have been integrated with multispectral MEIS II data by W. Moon and V. Singh and analysis is continuing.

PRODUCT:

Hard data tapes containing raw data from remote sensing. Residual anomaly maps indicating sites of metal-induced stress in vegetation.

Singh, V., Moon, W.M. and Fedikow, M.A.F.; 1988: An integrated remote sensing study of mineralized zones associated with the Agassiz Metallotect, Lynn Lake, Manitoba, I [MEIS II and biogeochemical study]; Manitoba Energy and Mines, Open File Report OF88-3; GSC OF1994.

Singh, V., Fedikow, M.A.F. and Rencz, A.N.; 1989: Analysis of multi-media data for exploration - an example from northern Manitoba; Seventh Thematic Conference on Remote Sensing for Exploration Geology: Methods, Integration, Solutions; Calgary, Alterta; October; (Oral presentation, poster display and abstract).

Singh, V., Moon, W.M. and Fedikow, M.A.F.; 1989: Correlation study of remote sensing and geological data for mineral exploration, Farley Lake area, Manitoba; I GARSS '89 and 12th Canadian Symposium on Remote Sensing, Vancouver, British Columbia, July (Oral presentation, poster display and abstract).

FOLLOW-UP AND IMPLICATIONS:

1. Airborne Survey of the Agassiz Metallotect by the Canada Centre for Remote Sensing.

2. Acquisition of the data tapes.

3. Merging remote sensing data with digitized geological, geophysical and geochemical data.

4. Computer-aided manipulation of acquired data is continuing.

Project 2.27 has provided a state-of-the-art examination of part of the Agassiz Metallotect (Project 2.4) utilizing integrated geological and remotely sensed data. The technical success of this project indicates that the necessary technology is functioning at the University of Manitoba and may now be applied to the remainder of the Agassiz Metallotect and other areas of interest in the province. The project has provided the mineral exploration industry in Manitoba with a tool capable of evaluating, in an integrated manner, local or regional areas of interest for indications of mineralization.

PROJECT 2.29: Mineral deposit documentation, Lynn Lake area

INVESTIGATOR: D.A. Baldwin

OBJECTIVES:

To establish the geological setting and controls on mineralization of selected mineral deposits in the Lynn Lake area.

PROGRESS:

The M.Sc. thesis by P. Olson has been completed and a copy has been received by the Geological Services Branch. Open File reports planned for the M.Sc. theses by D. Peck, S. Elliott and P. Olson have been postponed in order to concentrate on preparation of Mineral Deposit Series reports (see Project. 2.2). The theses are available on Interlibrary Loan through the University of Manitoba, Winnipeg, University of Waterloo, Waterloo, Ontario and University of Windsor, Windsor, Ontario.

PRODUCTS:

See Project 2.2 for Mineral Deposit Series Products.

FOLLOW-UP AND IMPLICATIONS:

Preparation of Open File reports based on three M.Sc theses have been postponed for at least one year.

PROJECT 2.32: Iron Formations in the Lynn Lake area

INVESTIGATORS: D.Parbery and M.A.F. Fedikow

OBJECTIVES:

To document the stratigraphic relationships between known iron formations and volcanic and sedimentary rocks in the Lynn Lake greenstone belt. A systematic program of geochemical profile sampling to examine the distribution of trace elements through the section.

PROGRESS:

Field work for the second and final summer of the Lynn Lake iron formations study was completed in 1988. Data collected from this survey is currently being compiled and will form the basis of a geological report and ten 1:5000 scale geological maps. Rock samples collected from high Mg-Ni-Cr basalts in these map areas will be compared to similar rock units at the MacLellan deposit. This geochemical study will be read as a paper at the upcoming Canadian Institute of Mining and Metallurgy conference in Quebec City (May, 1989). The field work has substantiated the presence of a laterally extensive volcanic and sedimentary sequence that extends 70 km+ from Motriuk Lake to southern Barrington Lake (Agassiz Metallotect). These rocks host the MacLellan, Nisku, Rainbow, Dot Lake and "K" Zones Au $\pm$ Ag deposits, and the Farley Au deposit that occurs in sulphidized oxide facies iron formation.. The recognition of layered tuffaceous, porphyritic, fragmental and pillowed, and possible reworked, equivalents of these rocks indicate the sequence is predominantly subaqueous in nature and holds promise for Au and/or base metal mineralization.

PRODUCTS:

1.Stratigraphic sections illustrating iron formation position in a sequence with respect to known mineralized zones.

2.Trace element content of iron formations, associated mineralization and associated rocks.

Fedikow, M.A.F., Parbery, D. and Ferreira, K.J., 1989: Geochemical target selection along the Agassiz Metallotect utilizing stepwise discriminant function analysis; Canadian Institute of Mining and Metallurgy, Quebec City, Symposium on "Hydrothermal Alteratin - How Good A Guide to Mineralization".

Parbery, D. and Fedikow, M.A.F., 1987: Investigation of Agassiz Metallotect stratigraphy; **In** Manitoba Energy and Mines, Report of Field Activities 1987, p. 12-16.

Parbery, D.T., 1988: Investigation of volcanic stratigraphy and iron formation occurrences, Lynn Lake area; **In** Manitoba Energy and Mines, Report of Field Activities 1988, p. 12-15.

FOLLOW-UP AND IMPLICATIONS:

This project will describe the geological and geochemical characteristics of iron-rich rocks, including banded iron formations, in order to generate new exploration concepts. The geochemical portion of this study will permit the identification of geochemical exploration targets within these rocks along the northern belt of the Lynn Lake greenstone belt.

PROJECT 2.33: Mineral deposit documentation, Ruttan Lake area

INVESTIGATOR: D.A. Baldwin

OBJECTIVES:

To investigate the geological setting of the Vol deposit and the gold potential of the Darrol Lake sulphide deposit.

PROGRESS:

Geochemical analyses for Au in 60 samples of drill core from the Darrol Lake deposit are completed. This completes the work required to meet the objectives of the project. The results of the field and laboratory components of the documentation of the Vol and Darrol Lake deposits will form part of an updated version of Open File OF 81-4.

PRODUCTS:

Geological Report GR86-1 "The geology of the southern part of the Rusty Lake volcanic belt" was released at the November 1988 Meeting with Industry. This report emphasizes the genesis of the volcanic and volcaniclastic rocks, the volcanic stratigraphy and the significance of the stratigraphy, emplacement mechanisms of various types of flow deposits, volcano eruption styles indicated by lithologies and emplacement mechanisms and volcano evolution.

FOLLOW-UP AND IMPLICATIONS:

An update of OF81-4 will be prepared to present results of geochemical data obtained.

PROJECT 4.1: Basal till investigations, Lynn Lake-Leaf Rapids area

INVESTIGATOR: E. Nielsen

OBJECTIVES:

To evaluate till geochemistry as a method of exploration for base and precious metals. Case studies of glacial dispersion are implemented in, and adjacent to, areas with known mineral occurrences. In addition, till geochemical anomalies are mapped in selected areas of little or no outcrop to aid in the search for mineralization.

PROGRESS:

Till sampling was completed in the Darrol Lake area. Geochemical analyses, which are almost complete, indicate only scattered and generally low gold concentrations that are interpreted as background values. Some multi-sample copper and zinc anomalies were encountered.

PRODUCTS:

Quaternary stratigraphy and Overburden geochemistry in the Phanerozoic terrain of southern Manitoba. (Open File Report)

Interlake Pb-Zn open file report is finished except for drafting.

FOLLOW-UP AND IMPLICATIONS:

LeClair Lake Open File report in progress.

PROJECT 5.1: 1:250 000 geological compilation, Churchill River-Lynn Lake area

INVESTIGATORS: M.T. Corkery, P.G. Lenton, D.E. Lindal

OBJECTIVES:

To synthesize and compile all geological data of Lower Churchill River-Lynn Lake area.

PROGRESS:

64F and 64G submitted to Cartography.

PRODUCTS:

64H and 54E printed in November, 1988.

FOLLOW-UP AND IMPLICATIONS:

64G and 64F to be printed in 1989.

PROJECT 5.3: Lynn Lake report and maps

INVESTIGATORS: H.V. Zwanzig, H.P. Gilbert and E.C. Syme

OBJECTIVES:

Geological maps and technical reports describing the geology and mineral occurrences in the Lynn Lake-Ruttan region are to be prepared in order to aid, and to focus, mineral exploration in this region.

PROGRESS:

Kamuchawie maps 50% redrafted by Cartography.

Lynn Lake sedimentary report 75% completed.

Lynn Lake-Kisseynew belt margin report 20% completed.

Barrington-Fraser report 85% completed.

PRODUCTS:

Scientific paper: "Stratigraphy and tectonics of the Kisseynew Complex, Manitoba"; submitted for GAC Special Paper on Trans-Hudson Orogen (see Section IV, OUTPUTS).

FOLLOW-UP AND IMPLICATIONS:

Reports describing the structure and the implication of zircon geochronology for the Lynn Lake area; the geology between Kamuchawie and Granville lakes; and the geology between Barrington and Fraser lakes, are to be completed in 1990.

GEOLOGICAL SURVEY OF CANADA

PROJECT C.1.1.2: Metamorphic studies: Kisseynew Gneiss Belt

INVESTIGATORS: T.M. Gordon (GSC/LCSD), S.L. Jackson (Queen's U.)

OBJECTIVES:

To elucidate the metamorphic history of rocks on the southern flank of the Lynn Lake greenstone belt. Thesis study of mineral assemblages and mineral compositions in pelitic and mafic rocks of the Wasekwan Group to document the chemical and mineralogical changes and pressure-temperature conditions during metamorphism and the relationship of metamorphism to deformation.

PROGRESS:

Project was completed during the 1988-89 fiscal year.

FOLLOW-UP AND IMPLICATIONS:

A limited amount of follow-up will continue under GSC A-base activities in Manitoba. Data from the five year project is contained within S. Jackson's Ph.D. thesis and in a Canadian Journal of Science paper that has been accepted for publication.

An understanding of the relationship of the Lynn Lake volcanic belt to the marginal sedimentary basins will allow industry to better evaluate the environment for its massive sulphide potential, as well as the relationship of major dip-slip faults to precious metal mineralization.

PRODUCTS:

Report GSC-17 in the 1988 Report of Field Activities

S.L. Jackson's Ph.D. Thesis, Queen's University.

CJES paper (in press)

PROJECT C.2.1.3: Agassiz remote sensing

INVESTIGATORS: W. Moon (U. of M.), A. Rencz (GSC/MRD)

OBJECTIVES:

To evaluate the contribution of integrated multi-type data analysis to geological mapping and mineral exploration using a portion of the Lynn Lake volcanic belt from the MacLellan Mine east to the Farley deposit. The digital image analysis system at University of Manitoba will be used to integrate the data available from this region.

PROGRESS:

The Geological Survey of Canada, under the scientific authority of A.N. Rencz, tendered a contract to Dr. Wooil Moon at University of Manitoba to investigate the application of digital data sets for the Agassiz Metallotect, Lynn Lake, Manitoba. The project concentrated on application of airborne remotely sensed data (MEIS-multi-detector electro-optical imaging scanner) and its relationship to ground-based geochemical and biogeochemical data. The project also investigated airborne geophysical data and satellite data from LANDSAT MSS.

PRODUCTS:

Report GSC-6 in the 1988 Report of Field Activities.

GSC Open File 1994 published April, 1989.

FOLLOW-UP AND IMPLICATIONS

This study will be completed by March 31, 1989. The refinement of this type of study is important in allowing explorationists to utilize an alternative multi-level approach to exploring in regions of heavy overburden and scarce outcrop.

PROJECT C.4.1.1 Geochemical surveys

INVESTIGATORS: R. Schmitt (GSC/MRD), P.W.B. Friske (GSC/MRD)

OBJECTIVES:

To conduct regional geochemical reconnaissance surveys in selected areas of Manitoba that will be determined in conjunction with the provincial survey. Sample collection, preparation and analysis will be contracted out, while the final open file production and release will be done by the GSC. Detailed fill-in survey and data interpretation will also be completed by the GSC.

PROGRESS:

The geochemical surveys in 1988 involved regional, detailed and interpretive programs. Regional lake sediment and water geochemical results from a survey conducted in 1987 over 21 600 km^2 of central Manitoba (63 H/NE, 63-I, 63 P/SE) were released as GSC Open File 1641 in July. The open file includes data from 1698 sites, representing an average of one sample per 12.7 km^2. Lake sediments were analyzed for Zn, Cu, Pb, Ni, Co, Ag, Mn, Cd, Fe, Mo, V, As, Hg, U, LOI, Sb and Au. Lake waters were analyzed for U, F, Ca, Mg, alkalinity and pH.

The results of a detailed lake sediment and water infill survey carried in August 1987 over part of the Lynn Lake and Rusty Lake greenstone belt and adjacent granitoid terrain are being prepared for release as a GSC Open File in late 1988. The survey outlines prospective areas for base and precious metal mineralization and provides data for evaluating lake sediment geochemical data in areas influenced by carbonate-rich till. The results of the infill geochemical survey will be integrated with an evaluation of geochemical, geological and geophysical data for map sheets 64B and 64C that is currently underway.

In August, R. Schmitt completed detailed multi-media geochemical sampling in the vicinity of Foster Lake (64C/10). The results of sampling to date indicate a complex process of gold mobilization from bedrock sources along the Johnson Shear Zone into surficial sediments, vegetation, ground and surface waters and lake sediments. Preliminary results were presented as part of a poster display at the Prospecting in Areas of Glaciated Terrain (PAGT) Conference in Halifax (September 1988). This study forms part of an M.Sc. study on gold mobilization into lake sediments being undertaken by R. Schmitt at University of Ottawa under the dirction of E.M. Cameron.

PRODUCTS:

Report GSC-14 in the 1988 Manitoba Report of Field Activities

Poster display at the PAGT conference in Halifax

GSC Open File 1959 on regional lake sediment and water survey, Lynn Lake-Leaf Rapids region.

FOLLOW-UP AND IMPLICATIONS:

By September, 1989, R. Schmitt will have completed an M.Sc. (Ottawa University) on the "Mobilization of gold into lake sediments".

There is no planned A-base supported follow-up of this MDA project.

PROJECT C.4.1.4: Drift Prospecting

INVESTIGATORS: C.A. Kaszycki (GSC/TS), R.N.W. DiLabio (GSC/TS)

OBJECTIVES:

To provide baseline information regarding regional ice flow patterns, dispersal directions, and drift composition in the Lynn Lake-Leaf Rapids-Flin Flon region (NTS 64B, C, F, G and 63 N, O), as an aid to mineral exploration in northwest Manitoba. This involves regional mapping of surficial deposits at 1:100 000 scale, systematic till sampling of the same areas to evaluate drift composition, and mapping both large and small-scale patterns of glacial dispersal. Regional sampling will be supplemented by more detailed studies in areas of potential economic interest identified on the basis of: anomalous till geochemistry, local bedrock geology, aeromagnetic and airborne anomalies, and modern lake sediment geochemistry. Specific objectives are: 1) to define the influence of local bedrock lithologies, particularly those that compose greenstone belts, on till composition and to determine if till lithology can be used to extend bedrock mappping in areas of extensive drift cover; 2) to evaluate the applicability of surficial geochemical surveys, including modern lake sediment geochemistry, in terrains dominated by various types of surficial deposits; and 3) to develop till sampling and analytical strategies for drift prospecting in areas of boreal forest where access is limited, clay cover is problematic, and drift composition is dominated by exotic debris (e.g. Paleozoic carbonate), thereby suppressing local bedrock signature.

PROGRESS:

Preparation of the final project report is well underway. Compilation of the regional geochemical data base is complete and data will be released as a single open file report this fall. Surficial mapping (1:100 000 scale) for NTS 64B, C, F, G and 63N has been completed and maps will be released as individual open file reports this fall. Compilation of the surficial geology for the entire region (1:250 000 scale) is nearing completion and will be released as a B-series map as part of the final project report. Master's theses examining a gold-arsenic anomaly at Wheatcroft Lake, and the acid neutralizing capacity of carbonte till on the Shield terrane of northwestern Manitoba are scheduled for completion this fall.

PRODUCTS:

Report GSC-15 in the 1988 Manitoba Report of Field Activities

Paper presented at the 1988 Manitoba Meeting with Industry

Paper presented at the 1989 GSC Current Research Forum

Posters presented at GSC and Manitoba Open Houses

E. Mongrain completed a B.Sc. study on gold in tills, Manigotagan region.

FOLLOW-UP AND IMPLICATIONS:

By May 1989, the GSC will open file four surficial geology maps at a 1:125 000 scale for NTS 64 B, F, G and 63N. A series of coloured maps at 1:250 000 scale for 64 B, C, F, G and 63N will be released by the spring of 1990.

A GSC open file on the till geochemistry of northern Manitoba will be released by June, 1989, and a GSC memoir on the surficial geology and till geochemistry of northwestern Manitoba will be published in the spring of 1990.

Two M.Sc. studies on the Wheatcroft Lake dispersal train and the acid neutralization capacity of glacial sediments in NW Manitoba will be completed by September, 1989.

There is no field work planned for the 1989-90 field season.

DISTRICT II: FLIN FLON - SNOW LAKE

1.5.1 1:20 000 mapping, Flin Flon area
1.5.3 1:10 000 mapping, Athapapuskow Lake
1.5.4 1:20 000 mapping, Chisel Lake-Morgan Lake
1.5.5 Tartan Lake geological mapping
1.6.2 1:20 000 Batty Lake mapping
1.7 Scout drilling, Project Cormorant
2.7 Gold deposits, Snow Lake area
2.9 Deposit documentation, Flin Flon
2.10 Deposit documentation, Sherridon
2.11 Industrial minerals investigations
2.12.2 Geologic setting, Vamp Lake deposit
2.12.4 Metallogeny of Felsic Intrusive Rocks, Flin Flon
2.24 Copper-zinc deposits, Snow Lake area
2.30 Mineral deposit geology - Flin Flon
5.6 Sub-Paleozoic compilation

DISTRICT IV: THOMPSON

1.11.1 Cross-Pipestone Lake mapping
1.11.2 Titanium-vanadium evaluation (report production)
1.11.3 Thompson belt supracrustal rocks
1.12 Uranium/lead geochronological sampling
1.16 Rubidium-strontium isotope investigations
1.16.2 Thompson geochemistry
5.7 Thompson-Pikwitonei compilation

Figure 10: Provincial Sector 'A' projects 1988 - Districts II and IV: Flin Flon-Snow Lake, and Thompson.

DISTRICT II: FLIN FLON-SNOW LAKE

Summary:

MANITOBA GEOLOGICAL SERVICES BRANCH:

Gold exploration has been active on the southern flank of the Burntwood gneissic belt where provincial mapping has delineated mineralized units considered by Gale and others to be a metallotect.

Geological mapping was completed this year in the Kisseynew region. Kississing Lake, Puffy Lake-Limestone Point Lake and Sherridon were mapped at 1:15 840 and compiled at 1:50 000. Revised names and relative ages have been suggested for the Sherridon and Nokomis Groups.

Mapping at Kississing Lake clarified the sequence of structural and metamorphic events, and confirmed previously inferred age relationships with aluminous graphite bearing gneisses of the Burntwood Metamorphic Suite underlying the younger predominantly quartzofeldspathic rocks and gneissic conglomerates of the Missi Metamorphic Suite.

Varna Gold Inc. explored a favourable horizon defined by Zwanzig and Seneshen in 1984, whilst Maverick Mountain and Pioneer Metals followed up anomalously high gold values detected by Ostry in the Puffy Lake region.

Geological mapping at 1:20 000 of the Tartan and Embury lakes areas traced faults and fault blocks, defined in the Flin Flon-White Lake area, north and west toward the Saskatchewan border, and showed that the Manistikwan-Bear Lake blocks can be clearly distinguished by the character of their mafic volcanic rocks.

Field work in the Athapapuskow project completed a three-year study of the area. The principal findings were: the demonstration of dextral movement on all northeast trending faults and shear zones in the eastern half of the area; identification of a 1 km wide east-northeast trending zone of intense deformation in southern Athapapuskow Lake (possibly continuous into Elbow Lake); the resolution of nearly all faults in the area into a single master structure corresponding to a southwest trending magnetic linear detected in the sub-Paleozoic to the south; and the delineation of a major relatively late, unfoliated, pyroxenite-peridotite in the West Arm-Athapapuskow region. An unusually thick (3 km) section of scoria-rich mafic pyroclastic material was discovered near the top of the Hook Lake block stratigraphy.

Mapping in the Flin Flon-White Lake area has demonstrated a stratigraphic association between rhyolite flow complexes and all massive sulphide deposits including those of Flin Flon, Schist Lake, Cuprus, White Lake, Centennial, and Trout Lake mines.

Trace element geochemistry has defined two major subdivisions of the Amisk Group: rocks with arc tholeiite affinity and basalts similar to those erupted in back-arc basins. All known massive sulphide deposits are restricted to the island arc association. A small but significant unit of pevolcaniclastic rocks contains clasts with shoshonite compositions, indicating a mature stage of arc development.

Pyroxene samples from weakly metamorphosed volcanic rocks in the Hook Lake Block were analyzed by microprobe to determine their minor element compositions, Mg:Fe ratio, and by inference their tectonic affinity. Results thus far suggest that primary magmas were subalkaline and emplacement was in a tectonic environment similar to modern island arcs.

A six week mapping program conducted over the Big Island Zinc property east of Manistikwan Lake helped define the stratigraphic setting of the mineralization as well as the alteration and associated structure.

Detailed mapping to the north and west of that completed in 1987 continued to examine altered, folded felsic fragmental rocks in the Leo Lake-Flintoba Lake area. Mapping of the Baker-Patton alteration zone identified a westward younging sequence including several newly identified felsic units, andesite flows and breccias, and a diatreme breccia. The role of faulting has a special significance in the interpretation of previous drill hole intersections.

Mineral occurrence documentation was completed in NTS areas 63J/12, 13, 63K/16 and 63-O/4. Mapping at 1:2500 of multi-element mineralization at Puella Bay in Wekusko Lake, was completed and detailed maps prepared for the vicinity of the Zona Occurrence.

Mapping projects at 1:5000 were completed in the Puffy Lake area and initiated at Squall Lake. The Main Zone of mineralization at Puffy Lake appears to be close to or contiguous with the axial trace of a prominent F2 fold.

Some of the samples taken from the Moose-Horn, Ballast Mine, McCafferty vein and Ferro Mine in the Wekusko Lake area yielded anomalously high Pt, Au and Pd concentrations, thus warranting further examination for PGE.

An examination of base and precious metal mineral potential of the Herblet and Pulver gneiss dome complexes was initiated this summer. Numerous zones of disseminated pyrite, pyrrhotite and chalcopyrite were examined. Aerially extensive alteration zones were observed at Pulver Lake, and a zone of undetermined extent containing 2-5% disseminated chalcopyrite with associated anthophyllite-garnet alteration was identified at Dowling Lake.

Humus geochemical studies were continued in the Snow Lake and Flin Flon areas in association with Westfield Minerals and Hudson Bay Exploration and Development Ltd.

Samples collected from metavolcanic rocks in the Snow Lake (Chisel-Morgan lakes) area demonstrated a tholeiitic and island-arc chemistry matching that of the Flin Flon region. A distinctive REE and trace element

chemistry was demonstrated for the footwall unit of the Chisel, Lost and Ghost mines base metal zone.

An U-Pb zircon age of 1889 +8/-6 Ma on the Richard Lake tonalite is very close to the 1886 Ma age obtained for Amisk Group volcanism at Flin Flon. This is consistent with previous proposals that the hydrothermal systems active during base metal volcanogenic sulphide deposition in the Snow Lake area were associated with and driven by synchronous subvolcanic felsic plutonism.

Six additional holes were drilled through the Paleozoic carbonates south of Flin Flon to provide further control for the ongoing compilation of basement maps in NTS areas 63K, 63J, 63F and 63G.

Industrial mineral activities included mapping of a granodiorite near Flin Flon, detailed mapping and sampling of a talc occurrence at Iskwasum Lake, as well as stripping and sampling a previously described marble occurrence at the Wekusko Quarry. A lease has subsequently been taken out on the marble quarry and several ASTM tests undertaken to confirm its suitability as dimension stone. Detailed mapping and sampling was also undertaken on an aplite-bearing pegmatite near the Manasan Quarry in the Thompson region, and a petalite bearing leucogranite at Red Sucker Lake.

GEOLOGICAL SURVEY OF CANADA:

In the Flin Flon-Snow Lake region, a study on the regional and detailed structural control on gold mineralization was completed, with some of the results presented orally to various local CIM meetings in Manitoba and Saskatchewan. A base metal project was initiated on the Chisel Lake open pit in cooperation with the Manitoba Geological Services Branch. The results will tie in to earlier alteration work by Skirrow (GSC Open File 1986) and with the continuing work by Edgar Froese on VMS-related alteration in the Cook Lake and Wolverton Lake regions. Eva Zaleski completed her doctoral study of the Linda volcanogenic massive sulphide occurrence; provincial U/Pb geochronological program is continuing to release results, thereby increasing our knowledge as to the complex tectonic history of the Trans-Hudson Orogen and its vast mineral potential. An airborne gradiometer/LF survey was completed over the File Lake-Snow Lake-Wekusko Lake region, completing coverage of the Flin Flon-Snow Lake Belt in both Manitoba and Saskatchewan. The results will be released by the fall of 1989.

Private sector exploration has been intense throughout the Flin Flon-Snow Lake region as well as the flanking regions to the north and south. GSC gradiometer surveys and Provincial scout drilling results were used extensively by private sector explorationists (Falconbridge, Hudson Bay Mining & Smelting, Granges, Cominco, W. Bruce Dunlop Ltd., and Manitoba Mineral Resources) as an aid to targetting exploration programs in the Project Cormorant area where basement is concealed beneath Paleozoic cover rocks. Varna Gold Inc. staked numerous claims and undertook line cutting and geological mapping in the Payuk Lake area, Granges Exploration Ltd. prospected ultramafic rocks discovered on the West Arm of Athapapuskow Lake and Saskatchewan Mining & Development Corporation engaged in line cutting and geochemical surveys in the Interlake area. MDA outputs were used in each of these programs and in others conducted by Ray D'Or, A.L. Parres and Falconbridge extensively to assist in initial area selection.

PROJECT DESCRIPTIONS

MANITOBA GEOLOGICAL SERVICES BRANCH

PROJECTS: 1.5.1: 1:20 000 scale geological mapping, Flin Flon area

INVESTIGATORS: A.H. Bailes and E.C. Syme

OBJECTIVES:

The objective of this project is to provide sound geological data base for future base metal and gold exploration in the Flin Flon region. Goals include: 1) production of high quality 1:20 000 scale geological maps, 2) stratigraphic subdivision of Amisk Group metavolcanic rocks, 3) definition of the stratigraphic framework of mineral deposits, and 4) identification of controls favourable to deposition of mineral deposits.

PROGRESS:

Manuscript prepared for printing.

PRODUCTS:

Report to be printed April, 1989.

FOLLOW-UP AND IMPLICATIONS:

Geological mapping has resulted in a detailed stratigraphic subdivision of Amisk Group metavolcanic rocks. The most significant structural features are a group of late faults and shear zones that divide the area into 10 fault-bounded blocks each with an unique stratigraphic succession. The mapping has for the first time allowed definition of the stratigraphic setting for each of the seven massive sulphide ore deposits in the area. Stratigraphic controls on mineralization are empirically determined to be:

1. Deposits are associated with rhyolite flows which form only a small component of a predominantly basaltic sequence;

2. Deposits are underlain by felsic, intermediate or mafic volcaniclastic rocks;

3. Deposits commonly occur within basinal structures;

4. Some deposits appear to be related to synvolcanic faults.

Follow-up studies include:

1. A paper by Syme (1989) entitled "Stratigraphy and geochemistry of the Lynn Lake and Flin Flon metavolcanic basalts, Manitoba" (see Section IV, OUTPUTS), provides a geochemical subdivision of the Amisk Group. It establishes that the Amisk Group is dominated

by rocks with trace and rare earth element geochemical characteristics consistent with an island arc environment.

2. U-Pb geochronology studies continue, with a view to establishing the relative ages of the various fault-bounded stratigraphic sequences and enclosed massive sulphide deposits.

3. Kinematic analysis of faults and shear zones, in support of ongoing mineral deposit studies of structurally controlled Au deposits.

PROJECT 1.5.3: 1:20 000 scale geological mapping, Athapapuskow Lake area

INVESTIGATOR: E.C. Syme

OBJECTIVES:

The primary objective of this project is to provide an updated and detailed geological data base for future base metal and gold exploration in the Flin Flon-Athapapuskow area. To that end, specific goals include: 1) production of high quality 1:20 000 geological maps, 2) definition of Amisk Group volcanic stratigraphy, 3) definition of stratigraphic and structural setting of mineral occurrences, 4) definition and extension of the major faults and folds that dominate the structure in the Flin Flon area, 5) thorough documentation of all mafic and felsic plutons, 6) geochemical characterization of volcanic and plutonic rocks with a view to furthering our knowledge of Proterozoic magma genesis, and 7) geochronology of Amisk Group and plutonic rocks.

PROGRESS:

Mapping in the Athapapuskow area was completed during the 1988 field season. Preliminary maps with new legends incorporating the geology of the entire area were produced in the fall of 1988. Preliminary report includes descriptions of units encountered during the current field season; with previous preliminary reports (1985-87) all major rock units in the area have been described. All major volcanic, plutonic and sedimentary units have been sampled for chemical analysis; there are currently 162 whole rock analyses on file. Compilation of field data has begun, in preparation for writing the final report.

PRODUCTS:

Progress report in Report of Field Activities 1988, four 1:15 840 scale Preliminary Maps.

Final report and maps (4 sheets, 1:20 000) - 1991.

FOLLOW-UP AND IMPLICATIONS:

Geological mapping has resulted in the stratigraphic subdivision of Amisk Group metavolcanic rocks. Geochemical characterization of the various basalt units suggests that there are back arc, island arc and mature arc types represented in a structural collage. The identification of basalt type is important because in the Flin Flon area it has been shown that all volcanogenic massive sulphide deposits are hosted by rocks with island arc-type geochemical characteristics. Massive sulphide orebodies in the Flin Flon area are also invariably associated with thin felsic flow or volcaniclastic units, and all rhyolite flows have now been identified in the Athapapuskow area. These felsic flows have been differentiated from compositionally similar rhyolite intrusive complexes that have a much lower potential to host massive sulphide deposits. Mapping of faults and shear zones has documented a regional pattern of deformation that has been used by A. Galley (GSC) to interpret structures hosting Au deposits. Intrusive rocks, ranging from fractionated tholeiitic ferrogabbro sills and layered mafic-ultramafic complexes to polyphase felsic plutons have been mapped in detail and may be evaluated by industry for Pt-group and Au mineralization.

Follow-up studies include:

1. Ph.D. student (at University of Calgary; supervised by T.M. Gordon, GSC) will begin work in 1989 on metamorphism in the Athapapuskow-Tartan Lake area.

2. Kinematic analysis of shear zones in the Athapapuskow and Flin Flon-White Lake area, in support of ongoing mineral deposits studies of structurally controlled Au deposits.

3. Compilation of geochemical data for a paper documenting Proterozoic volcanism .

4. Continuation of U-Pb geochronology studies, to establish the ages of major magmatic events.

PROJECT 1.5.4: 1:20 000 scale geological mapping, Chisel Lake-Morgan Lake area

INVESTIGATOR: A.H. Bailes

OBJECTIVES:

The objective of this project is to provide an improved geological data base for future mineral exploration in this base metal- and gold-rich mining district. A major goal is the development of a coherent regional volcanic stratigraphy and the identification of the position of mineral deposits within this stratigraphic framework. A further goal is to document the distribution and main characteristics of hydrothermal alteration zones associated with known and, as yet, undiscovered mineralized zones. Where possible, the environmental conditions that existed at the time of mineralization will be identified with a view to determining those conditions favourable to deposition of mineral deposits.

PROGRESS:

In 1988/89, 1:20 000 scale mapping of the Chisel-Morgan area was completed. Most activities were directed towards production of a preliminary map (1988S-1) and a written contribution to the 1988 Report of Field Activities.

Mapping of the Chisel-Morgan lakes area has identified major stratigraphic units and placed known base metal sulphide deposits within their stratigraphic setting. In the eastern two-thirds of the project area a dominantly north-facing, sequence of volcanic rocks over 5 km thick contains base metal sulphide deposits near the base,

middle and top of the section. 177 whole rock/trace element and 53 rare earth element (REE) analyses performed in 1988 established the geochemistry of major supracrustal units, larger intrusions and hydrothermally altered rocks. Mafic volcanic rocks display tholeiitic chemistry, show trace element characteristics comparable to Cenozoic arc lavas, and have chemistry similar to mafic lavas that host the major base metal sulphide deposits of the Flin Flon area. An important result of the geochemical investigations is the identification of a 700 m thick basalt-dacite-rhyolite sequence, in the immediate stratigraphic footwall to the Chisel-Lost-Ghost Zn-Cu sulphide zone; this sequence elevated dispersed element content and light REE enrichment. This provides Snow Lake explorationists with a chemically and lithologically distinctive marker unit that should prove valuable in tracing the Chisel-Lost-Ghost mineralized zone.

A U-Pb zircon age of 1889+ 9/-6 Ma was determined for the Richard Lake Pluton. It is comparable to the age of Amisk volcanism (1886+ 1.3 Ma) at Flin Flon. This provides the first direct evidence to support the widely held view that heat for hydrothermal alteration and base metal mineralization in the Snow Lake area was supplied by major synvolcanic plutons. The Richard Lake Pluton displays distinctly different trace and REE chemistry to the Sneath Lake Pluton, another potential synvolcanic intrusion.

In 1988, it was demonstrated that the Chisel structural basin, located between Chisel Lake and Ghost Lake, formed by the interference of two major folds, the northwest trending F1 Ghost Lake syncline and a younger unnamed north-northwest trending syncline. The Chisel-Lost-Ghost base metal mineralized zone occurs just below a distinctive mafic tuff and lapilli tuff unit on the south side of the structural basin. The implication is that similar mineralization may be found at this same stratigraphic position elsewhere in the Chisel structural basin.

PRODUCTS:

Two progress reports in Report of Field Activities 1988.

One preliminary map, 1:15 840

Two oral presentations.

Open File report and map in 1991.

FOLLOW-UP AND IMPLICATIONS:

This project demonstrates that 1:20 000 scale mapping in the Snow Lake area permits volcanic stratigraphy to be recognized and mapped in sufficient detail to be useful in aiding exploration for stratigraphically controlled base metal sulphide mineralization. In addition, geochemistry of major volcanic intrusive units has been shown to be important not only for characterizing these suites but, at least in one example (the Chisel footwall marker unit), to have direct input into identifying economically important rock packages.

In 1989/90 analysis and processing of data and samples will proceed with the objective of producing an interim open file report and map. In addition a new mapping project (Anderson-Wekusko) will be started with the objective of extending the Chisel-Morgan 1:20 000 scale mapping east to latitude 99°41'30". More detailed mapping at 1:5000 scale will be done in conjunction with A. Galley (GSC) with the objective of more completely defining the nature of footwall hydrothermal alteration and the stratigraphic control on the Chisel-Lost-Ghost base metal mineralized zone.

PROJECT 1.5.5: 1:20 000 scale geological mapping - Tartan Lake

INVESTIGATOR: H.P. Gilbert

OBJECTIVES:

To provide an up-to-date detailed geological data base in the northwestern part of the Flin Flon belt in well exposed areas of known and potential gold and base metal mineralization.

PROGRESS:

Mapping was extended west to Annabel Creek and along the north side of the map area to the south. The main elements of structure and stratigraphy have been defined and major fault and stratigraphic units correlated with the geology to the south. Mafic to intermediate volcanic rocks predominate the area except for the largely metasedimentary Embury Lake Block. Major overturned (F2?) folds and faults generally trend northwest to west, parallel to the regional stratigraphy but several major faults and one fold are discordant to these trends.

PRODUCTS:

Preliminary Map 1988F-5 Tartan Lake-Lac Aimee 1:15 840, supersedes 1987F/3.

Progress report in Report of Field Activities 1988.

Final map and report in 1992.

FOLLOW-UP AND IMPLICATIONS:

Major structures should be considered in exploration planning, especially discordant faults (implicated in gold mineralization by Galley). Locally quartz (+ tourmaline) veins are gold-bearing in the Tartan Lake area. Electro- magnetic conductors are locally coincident with the major block-bounding fault through Smook Lake. Base metals at Trout Lake Mine are associated with massive and fragmental felsic volcanic rocks that elsewhere in the Flin Flon district contain base metal mineralization.

PROJECT 1.6.1: 1:50 000 scale geological mapping of the Kississing Lake area

INVESTIGATOR: D.C.P. Schledewitz

OBJECTIVES:

The objective is to establish the lithology, stratigraphy and structure of the Kisseynew gneisses at Kississing Lake and to relate the various types of

mineralization in the area to these parameters. Once a systematic, comprehensive geological base for the Kississing Lake area has been established, a major objective is to compare this geology to that of the Sherridon Group and the mineral occurrences within the Sherridon Group at the type locality around Sherridon.

PROGRESS:

Mapping of the Kississing Lake area was completed. Part of Sherridon area was mapped.

PRODUCTS:

One preliminary map at 1:20 000 scale.

One progress report in Report of Field Activities 1988.

Compilation map (1:50 000) of 63N/3, 2, 1 W-1/2 and report (Open File), co-authored with H.V. Zwanzig, 1989.

Final maps and report, co-authored with H.V. Zwanzig, 1991/92.

FOLLOW-UP AND IMPLICATIONS:

Identification of a broad scale regional lithostratigraphy and the discrimination of different types of intrusive rocks provide a base for distinguishing localized variations in lithology, some of which are related to mineral deposition. The regional lithostratigraphy also provides a base for the recognition of possible stratigraphic discontinuities that may represent early thrust faults and a means of interpreting the younger supracrustal deformation. Structural analysis is particularly important since the region was complexly domed by intrusions and followed by deformation resulting in broad zones of mylonitic rocks and superposed folds. These complex folds have axes with shallow plunges and highly varied azimuths.

Much of the mineralization in the Kississing Lake area appears to be stratabound with numerous occurrences of barren sulphide enrichment in amphibolites. A significant observation is that more highly mineralized zones are considerably more complex than what and local stratigraphy varies from the regional what stratigraphy. In the areas of mineralization amphibolites are present but broad areas of a hornblende, cummingtonite, graphite, garnet, biotite, feldspar, quartz rock type are also present. Also present is a hornblende-rich quartzofeldspathic rock that contains disseminated sulphide and persistent traces of chalcopyrite, and rare concentrations of galena and sphalerite. These rock types are also present, but are more extensive, in the Sherridon area; however, extensive silicification and deformation has obscured the stratigraphic implications and possible relationship of the orebodies with the surrounding lithologies.

PROJECT 1.6.2: Kisseynew East, geological mapping

INVESTIGATOR: H.V. Zwanzig

OBJECTIVES:

The purpose of this project is to provide direction to base and precious metal exploration north of Flin Flon by establishing the stratigraphy, lithology, structure and mineral potential of geological formations east of Sherridon. Reliable geological data demonstrating stratabound or structural control of known mineral deposits will provide a basis to search for additional deposits.

PROGRESS:

Mapping at 1:50 000 scale of the Walton Lake, Spider Lake, Meat Lake and Martell Lake areas in 1988 marked the completion of field work for Kisseynew Project.

A preliminary compilation of rock types has been establishd based on field data alone. A selection of thin sections provides an overview of the petrography. The regional lithostratigraphy was extensively revised during the course of the project. Amisk Group metavolcanic rocks were traced north into the Kisseynew Metamorphic Complex. Turbidite-derived Burntwood River gneisses were traced south into the previously called Nokomis Group gneisses. The Sherridon Group was remapped as (i) type Sherridon gneiss, (ii) Missi Suite (equivalent to metasandstones and volcanic rocks in the Flin Flon Belt); and (iii) granitoid orthogneisses (equivalent to intrusive rocks to the south).

Preliminary structural analysis recognizes (i) tight, recumbent folds, commonly traced for 50 km, (ii) polyphase, superposed, synmetamorphic folds; and (iii) late faults and shear zones developed in a brittle-ductile transition _____ during retrograde metamorphism and uplift.

PRODUCTS:

One preliminary compilation map at 1:50 000 and Report of Field Activities 1988.

One Open File Report with a 1:50 000 (revised) compilation map (in preparation 1989), a final report and 1:50 000 and 1:20 000 maps will be prepared in 1991/1992.

FOLLOW-UP AND IMPLICATIONS:

The lithostratigraphic classification will be more clearly defined and the structure will be documented in detail. Economic geology is focussed on the outrolls of known and potential gold deposits. The mottled felsic gneiss member of the amphibolite unit at the top of the Burntwood River Suite is confirmed as a gold metallotect and continues to be an exploration target. However, the largest deposit (Puffy Lake) and best potential is within narrow belts of Amisk Group rocks caught up in the metamorphic complex. Quartz vein emplacement, and alteration along brittle/ductile shear zones in synmetamorphic axial planes during metamorphic retrogression should be investigated as a model for gold mineralization on the south margin of the Kisseynew Domain.

All of these gold deposits are near a stratigraphic or structural break between predominantly volcanic and predominantly sedimentary rocks. The nature of this break can be investigated further through mapping in the area north of Snow Lake, adjoining the new Anderson-Wekusko Project of Bailes and Galley (GSC).

Another follow-up project is the investigation of the Kisseynew Domain-Superior Boundary Zone margin planned to be started in 1992.

PROJECT 1.7: Scout drilling, Project Cormorant area

INVESTIGATORS: W. Weber, H.R. McCabe, W.D. McRitchie, I.T. Hosain and D. Berk

OBJECTIVES:

To assist in determining the geology of the Precambrian basement in an area of thin Phanerozoic sedimentary cover, by means of an in-house diamond drilling core hole program. This program is designed to ground-truth geophysical signatures detected by airborne gradiometer surveys in the Project Cormorant area.

PROGRESS:

Two diamond drill holes completed.

PRODUCTS:

Report in Geoscience Canada, co-authored with GSC personnel.

Progress report in Report of Field Activities 1988.

FOLLOW-UP AND IMPLICATIONS:

Results of the scout drilling are being used to produce a 1:250 000 geological map of the Precambrian basement and the Paleozoic cover. The drill hole data are also being used by the exploration industry, specifically Hudson Bay Mining & Development to supplement their own data in the search for Namew Lake-type Ni-Cu deposits in the region.

PROJECT 2.7: Gold deposits, Snow Lake area

INVESTIGATOR: M.A.F. Fedikow

OBJECTIVES:

To determine the geological controls of gold deposits in the Snow Lake area.

To establish the nature and genesis of those gold deposits and investigate possible exploration methodology for detecting similar types of gold mineralization.

PROGRESS:

Geological and geochemical information from Au occurrences in the Snow Lake area (NTS 63K/16 and 63K/9) have been compiled and will be released as Mineral Deposit Series Reports for NTS areas 63J/12, 63J/13, 63J/14, 63O/4 and 63N/1. Detailed, site specific studies undertaken by the GSC will complement these reports. Detailed mapping was initiated with G. Ostry at Squall and McLeod Lakes in 1988. Alteration studies stratigraphy and structure of the known mineralized zones at Squall Lake will form the basis of a site specific report on a mineral deposit within the Kisseynew Gneiss Domain in the Snow Lake area.

PRODUCTS:

The preliminary findings, stemming from field examinations in 1984, 1985 and 1986, are presented in the respective Reports of Field Activities. Detailed occurrence locations, geological maps and assay and geochemical results are available for inspection in a mineral deposit open file.

Fedikow, M.A.F., Ostry, G.M., Ferreira, K.J. and Galley, A., 1988: Mineral deposits and occurrences in the File Lake area, NTS 63K/16; Manitoba Mineral Deposit Series Report No. 5.

Ferreira, K.J. and Fedikow, M.A.F., 1989: Mineral deposits and occurrences in the Tramping Lake area, NTS 63K/9; Manitoba Mineral Deposit Series Report No. 7 (in prep.).

FOLLOW-UP AND IMPLICATIONS:

Detailed mineral occurrence studies on specific occurrences will commence with the completion of preliminary examinations in 1988. Progress reports describing the new findings will be released in the Report of Field Activities and in open file reports so that mining and exploration companies will be able to utilize relevant geological and geochemical mineral occurrence information.

PROJECT 2.9: Mineral occurrence documentation - Flin Flon area

INVESTIGATOR: G.H. Gale

OBJECTIVES:

This project is designed to provide detailed geological maps and descriptions of all known mineral occurrences in the Flin Flon area, provide a genetic classification of deposits, and delineate geologically favourable mineralized zones on 1:50 000 scale and 1:20 000 scale maps for further investigations.

PROGRESS:

Mineral Deposit Series Report and Maps for NTS areas 63K/16 have been published and those for NTS areas 63K/12 are in preparation.

PRODUCTS:

Gale, G.H. and Eccles, R., 1988: Mineral Deposit Series Report No. 2, NTS areas 63K/13/SW.

Gale, G.H. and Eccles, R., 1988: Mineral Deposit Series Report No. 3, NTS areas 63K/13/N.

Mineral Deposit Series Report for NTS areas 63K/12, 63K/11 and 63K/14 will be prepared by March 1990.

FOLLOW-UP AND IMPLICATIONS:

The recognition of structural and stratigraphic characteristics common to Flin Flon mineral occcurrences will permit the delineation of metallotects and thereby

focus base and precious metal exploration in the district. Detailed deposit scale projects will be commenced.

PROJECT 2.10: Kisseynew sedimentary gneiss terrain

INVESTIGATOR: G.M. Ostry

OBJECTIVES:

To provide a mineral deposit data base, identify geological factors controlling mineralization, and classify mineral occurrences into genetic types.

To establish the stratigraphic position of mineralization and determine stratigraphy on the southern flank of the Kisseynew sedimentary gneiss terrain.

PROGRESS:

Mapping at 1:5000 scale in the Puffy Lake area was completed. A first draft of a 1:5000 geology map of the area has been completed and selected rock samples have been submitted for thin section and geochemical and/or whole rock analysis. Basic mineral occurrence documentation has been completed on the south flank of the Kisseynew gneiss terrain. Contributions to 63K/16 Mineral Deposit Report and map are completed (see Projects 2.7 and 2.24). Text and map for the 63N/4 Mineral Deposit report is complete. Mineral Deposit Map Series reports and maps for 63N/1 (with M.A.F. Fedikow), 63N/2, 63N/3 and 63N/5 are in preparation.

PRODUCTS:

Report GS-14 detailing 1988 field work was published in the annual Report of Field Activities 1988. Unit descriptions, structural evidence and possible timing of gold mineralization in the Puffy Lake area were highlighted.

Mineral Deposit Map Series report and map for 63K/16 (with M.A.F. Fedikow and K.J. Ferreira) will be published by March 1989.

FOLLOW-UP AND IMPLICATIONS:

Mineral Deposit Map series reports for NTS areas 63N/1 to 63N/5 and an open file report of the geology in the Puffy Lake area are in various stages of preparation and will be completed by March 1990. The Mineral Deposit Series reports and maps and the report on the Puffy Lake area will provide a comprehensive data base of known mineralization and insight into gold and base metal metallogeny along the south flank of the Kisseynew gneiss terrain.

Effective mineral exploration techniques for precious and base metal mineralization will evolve from an understanding of the factors controlling the mineralization on the southern flank of the Kisseynew terrain.

PROJECT 2.11: Industrial minerals investigations, Flin Flon-Snow Lake region

INVESTIGATOR: W.R. Gunter

OBJECTIVES:

The purpose of this project is to evaluate reported occurrences of building stone, sillimanite and garnet in the Flin Flon-Snow Lake area. The deposits will be sampled to determine the suitability of the material for industrial mineral use; those deposits indicating potential will be examined in more detail. Additional examinations will take the form of detailed mapping, sampling and diamond drilling.

PROGRESS:

Field investigations of selected industrial mineral occurrences in the Flin Flon-Snow Lake region are complete. These studies were undertaken to provide a data base suitable for an objective appraisal of economic potential for various occurrences. Occurrences documented include: granite in the Flin Flon area; granite porphyry at Naosap Lake, talc at Iskwasum Lake, garnet-anthophyllite-sillimanite gneisses in the Sherridon area for garnet content; kyanite, sericite and garnet contents associated with base metal deposits in the Snow Lake area; and dolomite in the Cranberry Portage to Ponton areas. Investigations include petrological and mineralogical studies, detailed maps of selected occurrences, polished samples of granite and dolomite and engineering tests of selected samples.

PRODUCTS:

Comprehensive data base on selected industrial mineral occurrences. Reports GS-17 and GS-25 in 1988 Report of Field Activities. Public lecture on Industrial Minerals Potential in northern Manitoba presented to the Canadian Institute of Mining, in February 1989, in Flin Flon and Lynn Lake.

Final report on "Industrial Mineral Potential in northern Manitoba" will be completed in April 1989 (see also Project 2.5).

FOLLOW-UP AND IMPLICATIONS:

High Potential industrial minerals sites in the Flin Flon-Snow Lake area were documented for the first time. Local prospectors are conducting feasibility studies for potential dolomite quarries.

PROJECT 2.12.2: Geological setting, Vamp Lake deposit

INVESTIGATORS: P. Laznicka and R. Wadien (U. of Manitoba) and G.H. Gale

OBJECTIVES:

To provide a detailed geological description and interpretation of the gold-bearing massive sulphide deposit at Vamp Lake.

PROGRESS:

A first draft of the M.Sc. thesis by R. Wadien has been submitted and reviewed. The thesis is currently undergoing revision.

PRODUCTS:

None in 1988.

FOLLOW-UP AND IMPLICATIONS:

M.Sc. thesis should be completed by September 1989.

PROJECT 2.12.4: Metallogeny of felsic intrusions, Flin Flon area

INVESTIGATORS: N.M. Halden and G.H. Gale

OBJECTIVES:

To establish the metallogeny and genesis of felsic intrusive rocks in the Flin Flon-Snow Lake greenstone belt, Manitoba, and to establish a geochemical data base for felsic intrusive rocks in the Flin Flon-Snow Lake greenstone belt.

PROGRESS:

520 rock analyses have been completed for major and trace elements. Follow-up field examinations were undertaken in the Snow Lake area. A preliminary report has been prepared for internal use. A suite of 50 samples are awaiting rare element analysis in February 1989. The final report should be submitted by May 1989.

PRODUCTS:

520 major element analyses.

An abstract, based on the preliminary report, has been submitted for the IGCP Helsinki meeting on granites.

FOLLOW-UP AND IMPLICATIONS:

It is anticipated that there will be a number of publications in referred journals arising from this subject.

PROJECT 2.24: Copper-zinc deposits, Snow Lake area

INVESTIGATOR: M.A.F. Fedikow

OBJECTIVES:

To ascertain stratigraphic and structural controls of rock sequences hosting known copper-zinc deposits in the Snow Lake area.

To establish the nature and genesis of those copper-zinc deposits and investigate possible exploration methodologies for detecting previously unknown copper-zinc mineralization.

PROGRESS:

Mineral deposit documentation is complete in the Snow Lake area of the Flin Flon-Snow Lake greenstone belt.

PRODUCTS:

Geological and geochemical information from Cu-Zn occurrences in the Snow Lake area (NTS 63K/16 and 63K/9) have been compiled and will be released as Mineral Deposit Series Reports No. 5 and 7, respectively. The remainder of the information will be released in Mineral Deposit Series Reorts of NTS areas 63J/12, 63J/13, 63J/14, 63O/4 and 63N/1.

Fedikow, M.F.A., Ostry, G.M., Ferreira, K.J. and Galley, A., 1988: Mineral deposits and occurrences in the File Lake area, NTS 63K/16; Manitoba Mineral Deposit Series Report No. 5.

Ferreira, K.J. and Fedikow, M.F.A., 1989: Mineral deposits and occurrences in the Tramping Lake area, NTS 63K/9; Manitoba Mineral Deposit Series Report No. 7 (in prep.).

FOLLOW-UP AND IMPLICATIONS:

The mineral exploration industry will receive a detailed geological description of examined mineral occurrences and accompanying assay data. This will assist in the recognition of favourable mineral deposit environments for focussed and concentrated exploration efforts.

PROJECT 2.30: Mineral deposit geology - Flin Flon

INVESTIGATOR: G.H. Gale

OBJECTIVES:

To establish the geological setting and origin of selected mineral occurrences in the Flin Flon area.

PROGRESS:

Field work was completed in the Alberts Lake-Leo Lake area. A six week field program was undertaken on the Westfield Minerals, Big Island zinc deposit. Three weeks of field work were used to complete a surface map of the Baker Patton project area.

PRODUCTS:

1:5000 geological maps of the Leo Lake-Alberts Lake area, Big Island zinc property area and the Baker Patton area. Reports GS-11, GS-12 and GS-13 were published in the 1988 Report of Field Activities.

FOLLOW-UP AND IMPLICATIONS:

Recently generated geological maps have provided new insights into the volcanic stratigraphy and structure of these three areas. Geological reports for this project will be postponed until completion of Project 2.9 reports and maps.

GEOLOGICAL SURVEY OF CANADA

PROJECT C.1.1.1: Metamorphosed alteration zones

INVESTIGATORS: E. Froese (GSC/LCSD); E. Zaleski, M. Leroux (U. of Manitoba)

OBJECTIVES:

To investigate and describe the mineralogy of hydrothermal alteration zones associated with metamorphosed massive sulphide deposits.

PROGRESS:

E. Froese continued studies on the synvolcanic, massive sulphide-related alteration zones at Cook Lake

and Wolverton Lake, near Snow Lake, Manitoba. Petrographic work is being complemented by electron probe analysis. This study will further define the relationship of the zonation within the alteration, and its relationship to base metal deposits. E. Zaleski is continuing her doctoral study at the University of Manitoba of the Linda massive sulphide zone near Snow Lake. Detailed investigations of the relationship between the sulphide lens and related footwall alteration zones, and of the sequence of deformation affecting these rocks, has contributed to the understanding of the region's complex structural and metamorphic history. Another alteration study is being completed by M. Leroux for a Master's degree at the University of Manitoba. The study is on garnet-anthophyllite rocks of the Star Lake area near Sherridon.

E. Froese and K. Ashton visited selected occurrences of altered rocks in the Sherridon area. The Sherridon Group at Sherridon, including carbonate and Fe-Mg amphibole-bearing rocks, were compared with a very similar sequence at Wildnest Lake, Saskatchewan. Because this sequence, according to work by K.E. Ashton, can be traced into Amisk Group rocks of the Flin Flon volcanic belt, some doubt is cast on the previously suggested correlation of Sherridon Group with Missi Group. The possibility should be considered that the sulphide deposits and altered rocks of the Sherridon Group are of Amisk age.

PRODUCTS:

Report GSC-1 in the 1988 Manitoba Report of Field Activities

Report GSC-18 in the 1988 Manitoba Report of Field Activities

Short course on metamorphic petrology at University of Manitoba

Paper presented at 1988 GAC (Zaleski)

FOLLOW-UP AND IMPLICATIONS:

By May, 1989, E. Zaleski's Ph.D. thesis (University of Manitoba) on the "Metamorphism, structure and petrogenesis of the Linda volcanogenic massive sulphide deposit, Snow Lake, Manitoba" will have been received by the GSC.

It is hoped that the alteration studies completed during this five year period will form the basis for successor studies on the spatial and genetic relationships between synvolcanic alteration and massive sulphide deposits.

Metamorphic studies are continuing in the Flin Flon-Snow Lake Belt, with doctoral studies under T.M. Gordon in the Flin Flon region and under E. Froese in the Elbow Lake region.

PROJECT C.1.1.3: Geochronology of the Churchill Province

INVESTIGATORS: T.M. Gordon (GSC/LCSD), P.A. Hunt (GSC/LCSD)

OBJECTIVES:

To sample selected areas for subsequent zircon U/Pb work that will assist geoscience workers in the Trans-Hudson Orogen to better understand the magmatic and metamorphic evolution of these rocks. Work completed over the time of the MDA agreement will complement other GSC projects, and will be arranged in consultation with Manitoba.

PROGRESS:

This Geological Survey of Canada-Manitoba Energy and Mines joint project was designed to: 1) establish the absolute timing of regional scale geological events in the Lynn Lake, Rusty Lake, Kisseynew, Flin Flon belts; and 2) provide controls for local stratigraphic and structural studies. Results of the first phase are published and in press, and are summarized in Figure GSC-2-1 and Table GSC-2-1. Work on particular problems is continuing.

Volcanic rocks in the Lynn Lake and Flin Flon belts were deposited at ca. 1900 Ma (Fig. GSC-2-1a). The Cliff Lake pluton and Richard Lake tonalite are similar in age to the Amisk Group at Flin Flon suggesting that they were subvolcanic and hence possible heat sources for local hydrothermal systems. The age of orthogneiss in the Herblet Lake gneiss dome supports the interpretation that the southern flank of the Kisseynew gneiss belt is a metamorphosed extension of the Flin Flon belt.

At ca. 1875 Ma (Fig. GSC-2-1b) pre-Sickle granitoid rocks intruded the isoclinally folded Wasekwan Group in the Lynn Lake belt. Rhyolite in the Karsakuwigamak block in the Rusty Lake belt is comparable in age to these intrusions, demonstrating that the two volcanic belts have separate histories.

From ca. 1860 Ma (Fig. GSC-2-1c) widespread plutonism produced the Wathaman-Chipewyan batholith as well as the Lynn Lake pluton on Athapapuskow Lake, and the large central plutonic complex in the Cormorant Lake area. Recent GSC work in Saskatchewan (Delaney et al., in process) shows that the uplift and erosion of the plutons resulted in the deposition of the Ourom Lake arkose near the end of this time period at 1850 +/-1 Ma.

Sills in the Kisseynew belt were emplaced at 1830 Ma, essentially synchronous with plutonism and Missi Group volcanism in the Snow Lake area (Fig. GSC-2-1d) the Missi Group age is significantly different from that of the Ourom Lake arkose, demonstrating that the various "arkose" sequences in the Churchill Province cannot be considered time-equivalent.

The timing of regional metamorphism is established by the ages of anatectic rocks in the central Kisseynew belt at ca. 1815 Ma (Fig. GSC-2-1e). Metamorphism affects the Missi Group and postdates most folding, constraining the two major periods of deformation observed in the Flin Flon belt to 1830-1815 Ma.

The latest movement on northwest to northeast-trending faults juxtaposes rocks of different metamorphic grade, hence must be post-1815 Ma.

PRODUCTS:

Report GSC-2 in the 1988 Manitoba Report of Activities

Paper in GAC Special Volume "Geology of the Early Proterozoic Trans-Hudson Orogen" in press

FOLLOW-UP AND IMPLICATIONS

Limited sampling and analysis will continue under GSC A-base programming.

The differentiation between synvolcanic and syntectonic plutons in the belt, by age dating, will allow industry to refine their target areas for base metal exploration. The larger scale implications of this program include a better understanding of the magmatic and metamorphic history of the Trans-Hudson Orogen.

PROJECT C.1.2.1: Project Cormorant; interpretation of sub-Phanerozoic geology

INVESTIGATORS: J. Dugal (GSC/LCSD), L.J. Kornik (GSC/LCSD), T.M. Gordon (GSC/LCSD)

OBJECTIVES:

To investigate, map, and interpret Precambrian geology beneath Paleozoic cover rocks adjacent to the edge of the exposed Shield. The project involves geological compilation, modelling of geophysical anomalies, correlation with exposed surface geology, geological synthesis of basement geology, selection of targets for drilling, logging of already available and new drill core, and production of the final synthesis. The GSC will be responsible for drilling in areas not accessible from roads. All of the above will be done in close consultation with the Manitoba Geological Services Branch.

PROGRESS:

The Geological Survey of Canada conducted a winter drilling project in the Clearwater-Moose Lakes area to obtain information on Precambrian rocks occurring 86-100 m beneath a cover of overburden and Paleozoic dolomite and sandstone. The data, combined with information obtained from previous projects and aeromagnetic vertical gradient and total field surveys,will be used to compile a 1:250 000 scale map of the sub-Paleozoic geology of the Cormorant map sheet (NTS 63K).

Seven vertical AQ boreholes, totalling 762 m were drilled by the project in different magnetic domains as interpreted by Blair et al., (1988) from aeromagnetic total field surveys. Four of the holes were successfully drilled into Precambrian rocks. The remaining holes failed to penetrate the unstable sandstone formation at the base of the Paleozoic cover, or the upper sections of the Precambrian rocks, which are highly weathered in the study area. Geological logs and a record of magnetic susceptibility measurements for the various rock types were produced to assist in the interpretation of the aeromagnetic surveys.

In June 1988, the core from 65 Manitoba Energy and Mines and 8 Geological Survey of Canada boreholes drilled in the Cormorant Lake area were re-examined. Magnetic susceptibility values for each rock and dip measurements for planar lithological features were recorded.

Recent aeromagnetic vertical gradient and total field surveys have been completed for most of the Project Cormorant area (NTS 63K) under the Federal/Provincial Northlands and Interim Agreements and as part of a 1984-89 Canada-Manitoba Mineral Development Agreement.

PRODUCTS:

Report GSC-4 in 1988 Manitoba Report of Field Activities.

Poster presented at the 1988 Manitoba Meeting with Industry.

FOLLOW-UP AND IMPLICATIONS

A 1:250 000 scale map of 63K will be open filed with the geology of the exposed and sub-Phanerozoic portions of the map sheet.

The refinement of techniques to interpret the geology of the Shield below the Phanerozoic will assist explorationists to evaluate the region's mineral potential.

PROJECT C.2.1.1: Flin Flon-Snow Lake metallogeny

INVESTIGATORS: A.G. Galley (GSC/MRD), J.M. Franklin (GSC/MRD)

OBJECTIVES:

To obtain an understanding of controls in gold and massive sulphide deposits, with an emphasis on alteration, structure, petrology and isotope geochemistry. The project represents a continuation of existing studies and will involve: regional setting of gold mineralization in light of the tectonic history of the area and, examination of alteration associated with volcanogenic massive sulphide deposits.

PROGRESS:

First drafts of open files on the Snow Lake and Wekusko regions are complete. These reports will include descriptive material, geochemical and structural data, and analysis of the lithologies and structures associated with gold occurrences. Field work was initiated on the Chisel Lake volcanogenic massive sulphide deposit now exposed in an open pit. 1:300 scale mapping defined eight different alteration zones associated with the deposit. Visits were made to the Puffy Lake, Tartan and McLellan gold mines to compare setting with gold occurrences examined in the Snow Lake, Wekusko and Elbow Lake regions.

PRODUCTS:

Report GSC-4 in 1988 Manitoba Report of Field Activities.

Talks were presented to CIM branch meetings in Flin Flon, Lynn Lake and Saskatoon on aspects of gold metallogeny in the Southern Churchill Province.

Co-authored provincial mineral deposit inventory publication for 63K/16.

Poster display at 1988 Manitoba Meeting with Industry on the Chisel Lake deposit.

FOLLOW-UP AND IMPLICATIONS:

Three open files will be published on Flin Flon-Snow Lake gold studies by September 1989, and a final GSC volume on Early Proterozoic gold metallogeny will be completed by March, 1990. Contributions will be made to the provincial mineral deposit inventory publications on 63K/15 and 63J/13.

Field work will continue with Al Bailes of the Manitoba survey to complete mapping of the Chisel Lake, open pit, and 1:5000 scale mapping of the alteration zone below the deposit. A tour of the massive sulphide deposits of northern Manitoba will be carried out with the possibility of initiating a multi-year massive sulphide study.

PROJECT C.2.2.1: Metallogeny of mafic-ultramafic rocks: Flin Flon-Snow Lake belt

INVESTIGATORS: J. Young, L. Ayres (U. of Manitoba); R.F.J.Scoates (GSC/MRD)

OBJECTIVES:

To characterize mafic-ultramafic bodies in the Flin Flon-Snow Lake area with emphasis on their potential to host magmatic sulphide (Ni-Cu-PGE) and oxide (Cr-Ti-V) mineralization. The first phase will involve mapping, sampling and petrological characterization of the major bodies in the belt over a two year period. The second phase will include more detailed studies of selected bodies and mineralization. The first phase is being undertaken under contract to the University of Manitoba.

PROGRESS:

Field work on this project was completed under contract to Lorne Ayres of the University of Manitoba, under the supervision of Jon Scoates (GSC), with data collected on the chemistry and internal stratigraphy of several of the important mafic-ultramafic intrusions within the belt. Jeff Young, a graduate student with the Department of Geological Sciences, is now in the process of completing a comprehensive report on the results of the study. Samples collected during the study are being selectively analyzed for platinum group element concentrations.

PRODUCTS:

Report GSC-7 in 1988 Manitoba Report of Field Activities

Open file in preparation for release September 1989.

FOLLOW-UP AND IMPLICATIONS:

J. Young will complete his M.Sc. study by spring 1990. Mapping of the mafic-ultramafic intrusions will allow explorationists to define portions of the sills that have PGE potential.

PROJECT C.2.2.2: Metallogeny of mafic-ultramafic rocks: Northern Churchill

INVESTIGATOR: L. Hulbert (GSC/MRD)

OBJECTIVES:

To characterize mafic-ultramafic bodies with emphasis on their potential for magmatic sulphide (Ni-Cr-PGE) and Oxide (Cr-Ti-V) deposits. One component will provide data on the platinum metal concentrations in known mineralization; another will document the character of some mineralized mafic-ultramafic bodies.

PROGRESS:

Research for the period from March 31 to September 26, 1988, was confined to detailed mineralogical and geochemical studies on a number of intrusions from the Lynn Lake greenstone belt. Further detailed electron microprobe analyses have been conducted on the Fe-Ti-V mineralization and enclosing host rocks of the Tow Lake intrusion. The Fe-Ti-V mineralization occurs in the form of titaniferous magnetite and ilmenite in thick magnetite-orthopyroxene-plagioclase cumulates and magnetite cumulates. The titaniferous magnetite contains 0.58-5.2 wt.% TiO_2 and 0.86-1.40 wt.% V_2O_3 in solid solution. It was found that the lower the Ti content in solid solution the higher the corresponding vanadium content. The most important source of Ti in the samples is present in the form of ilmenite. Ilmenite was found to be the high titanium variety with values in the 51.67-52.99 wt.% TiO_2 range, with V_2O_3 contents ranging from 0.39-0.89 wt.%. Fortunately, the Cr_2O_3 contents of the associated Ti-magnetite is low, 0.0-0.20 wt.%, a metallurgically desireable feature of exploitable Fe-Ti-V oxide mineralization. The surrounding rock contains plagioclase that ranges from An (53-47) and orthopyroxene from En (65-61). Reaction olivine, forming between orthopyroxene and magnetite, was found to have a compositional range of forsterite (57.5-55). These chemical features suggest that this Fe-Ti-V rich oxide layer is very similar to the magnetite layers in the basal portion of the Upper Zone of the Bushveld Complex. The main magnetite layer is exploited for V, Fe and Ti.

Detailed sampling for Pt, Pd, Au and Rh analyses across the width of the intrusion indicates that all samples contain levels less than the detection limits for Pt (1 ppb), Pd (2 ppb) and Rh (2 ppb). The highest gold value was 3 ppb. Analyses for Se, As, Te, Sb,Br, and Ge on these same samples also suggested very low levels of precious metals. Similar analyses to those above were conducted on samples from the Fraser Lake Complex and the Sickle Lake intrusion. New analyses of the mineralized samples from Fraser Lake confirm the previous low levels. Eight new ICP-MS analyses suggest a mean value of approximately 4 ppb for Pt, Pd and Au for well mineralized samples. The palladium values ranged from 2-15 ppb. Twenty analyzed unmineralized samples from the Sickle Lake intrusion suggest a mean of 8 ppb for palladium and platinum and 4 ppb for gold. Sporadic values as high as 63 ppb for Pt and 50 ppb for Pd were

obtained. The values associated with the Sickle Lake intrusion are anomalous relative to all the other intrusions in the area. However, it still remains clear that the sulphide mineralized and unmineralized basic and ultrabasic intrusions in the Lynn Lake greenstone belt have anomalously low levels of platinum group elements.

Analyses of basalts (for PGE by stable isotope dilution ICP-MS) from the Magrath, Barrington, Tod, Hughes, Miskwa, Cockeram and Hughes lakes areas of the Lynn Lake greenstone belt, as well as Division B and D of the Northern Belt, suggest that these basaltic volcanic rocks have very high levels of platinum and palladium. Not only are these levels anomalous for volcanic rocks on a world scale, but they also contain greater values than the unmineralized and weakly mineralized mafic-ultramafic intrusions in the Lynn Lake greenstone belt. It is believed that the high levels of Pt and Pd in the associated volcanics suggests a rather fertile mantle source for the first stage of partial melting and coeval volcanics. However, second stage (the mafic-ultramafic intrusions) partial melt derived from the same source are PGE-poor because they are being derived from an area that has already been depleted in PGE.

PRODUCTS:

GSC Open File 1440.

Report GSC-8 in 1988 Manitoba Report of Field Activities.

CJES paper (in press).

FOLLOW-UP AND IMPLICATIONS:

A paper has been accepted by the Canadian Journal of Earth Sciences by L. Hulbert on "Nd-Sm, Rb-Sr, and Oxygen isotopic constraints on Early Proterozoic mafic-ultramafic intrusions in the Trans-Hudson Orogen". Data on all mineralized mafic-ultramafic intrusions in the Trans-Hudson Orogen in Manitoba and Saskatchewan will be open filed by September, 1989, followed by the publication of selected papers.

PROJECT C.3.1.1: Gradiometer surveys

INVESTIGATOR: E.E. Ready (GSC/GEOPH)

OBJECTIVES:

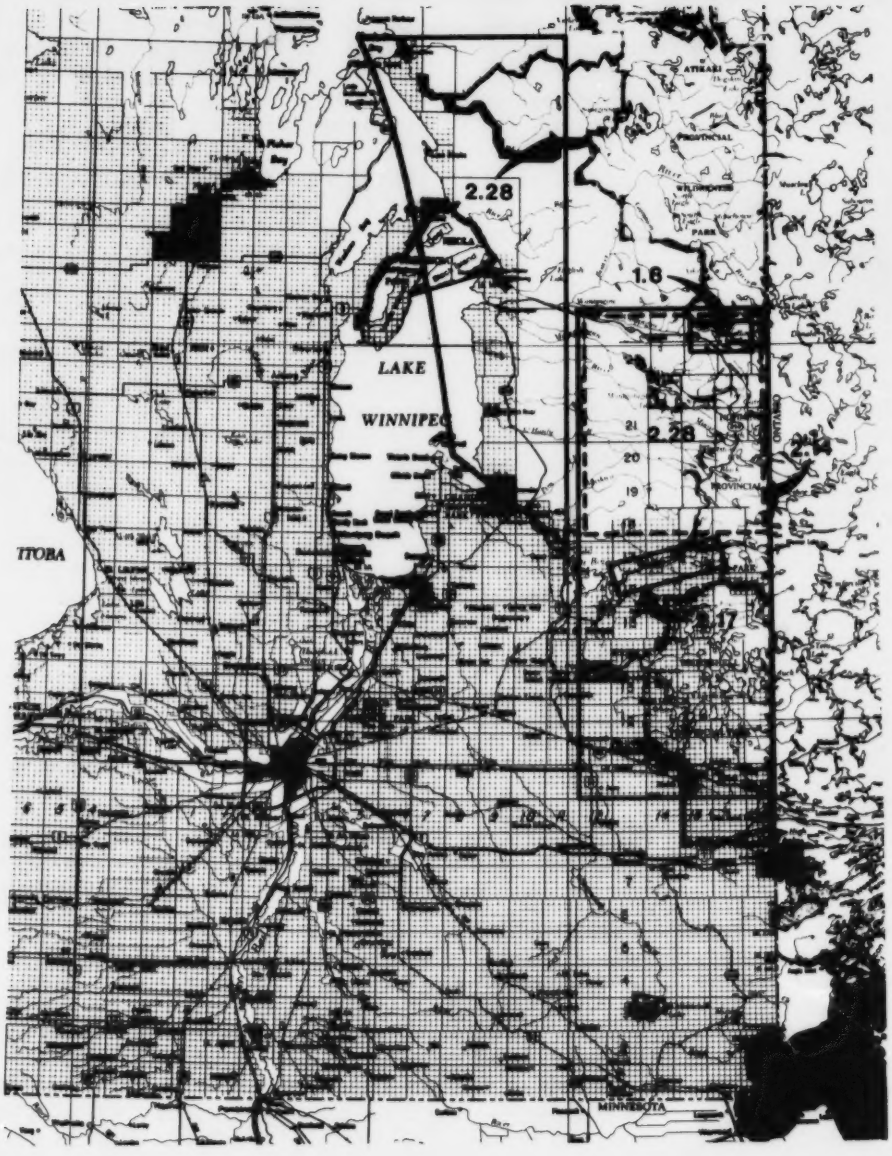
To provide complete high resolution aeromagnetic gradiometer maps, VLF profile data or EM data for areas selected in conjunction with the provincial survey. The work will be contracted out and supervised by the GSC.

PROGRESS:

All surveys planned for the five year program have been completed. The high resolution aeromagnetic total field and vertical gradiometer final maps for the Hargrave, Moose Lake, Namew Lake, Root Lake and Elbow Lake regions have been published. High resolution aeromagnetic total field and time-domain electromagnetic survey maps were published for MacMillan Lake, Suttie Lake and Zed Lake areas, Lynn Lake region.

FOLLOW-UP AND IMPLICATIONS:

High resolution aeromagnetic total field and vertical gradiometer maps for the File Lake, Snow Lake and Wekusko Lake areas will be completed and published.



DISTRICT III: SOUTHEAST MANITOBA

1.8 Rice Lake geological mapping
2.14 Deposit documentation, Rice Lake area
2.17 Platinum element evaluation
2.28 Dimension stone resources assessment

Figure 11: Provincial Sector 'A' projects (1988) - District III: Southeast Manitoba.

DISTRICT III: BISSETT (southeastern Manitoba)

Summary:

MANITOBA GEOLOGICAL SERVICES BRANCH:

Recent forest fires in the Bissett district have added greatly to the amount of outcrop available for documentation. Detailed remapping of the metavolcanic and metasedimentary units appears warranted in the region between Wallace and Gem lakes.

The inventory of potential building stone in southeast Manitoba was extended to include granitic rocks close to Lake Winnipeg in the Berens and Pigeon rivers region. No new prospects were found, most outcrops being closely fractured and intruded by younger dykes. However, several companies have applied for quarry leases in areas identified as having building stone potential, e.g. Tie Creek.

The initial inventory of sphagnum bogs in the Interlake resulted in publication of a report by the Manitoba Remote Sensing Centre based on the Landsat V Thematic Mapper. The technique has promising applications for more widespread use.

As an adjunct to the field program industrial minerals staff also facilitated and acted as advisors to Sector C activities that resulted in installation of granite curbing, cobblestones, and bollards in downtown Winnipeg.

Vegetation geochemical studies continued in the general vicinity of Bissett.

Anomalously high levels of Pd and Au were detected in one of four samples obtained from the Mirage property.

Almaden Resources initiated a geophysical and drilling program in the Whitemouth area following publication of a sub-Quaternary Precambrian basement compilation in 1987.

GEOLOGICAL SURVEY OF CANADA:

In Southeast Manitoba, studies on the metallogeny of the Bird River Sill and Falcon Lake Intrusive Complex were completed. Detailed maps of the distribution of chrome within the Bird River Sill will be released this summer, followed by a report on the PGE distribution within a portion of the Sill. Of the three theses commissioned on the Falcon Lake stock by the GSC, one on the internal stratigraphy of the sill by Bill Mandziuk (U. of M.) has been completed, with results published in the Canadian Mineralogist. The two others by P. Tirschmann (petrology) and J. Fingler (gold study) will be completed by the fall. A report combining the results of all three studies will be open filed by November, 1989.

Gold-related structural, alteration and fluid inclusion studies in the region centered on the San Antonio Mine were completed, with the data presented in M.Sc. theses by Doreen Ames and Sabastian Lau. Structural studies around the Gunnar, Central Manitoba and Oro Grande gold deposits in the Beresford Lake region were initiated, and will continue as part of Tex Brommecker's M.Sc. thesis. A cooperative GSC/MGSB Quaternary project on gold in tills was completed in the Manigotagan region.

PROJECT DESCRIPTIONS

MANITOBA GEOLOGICAL SERVICES BRANCH

PROJECT 1.8: Rice Lake geological mapping

INVESTIGATOR: W. Weber

OBJECTIVES:

To undertake lithologic and structural mapping of geological environments with known or suspected potential for gold mineralization to improve targeting criteria for exploration.

PROGRESS:

Inability to hire qualified senior geological assistant led to a reduced field program in the Beresford and Wallace Lakes area.

PRODUCTS:

Progress report in Report of Field Activities 1988.

FOLLOW-UP AND IMPLICATIONS:

The program yielded more specific and detailed data in parts of the greenstone belt, particularly in some burnt-over areas. These data form the basis for specific work to be undertaken in the future. The mapping has established the geological environment at the terminal phase of arc volcanism, the fact that Wallace Lake supracrustal are likely a platform facies that is older than the arc volcanism, and a structural lithological control for Lily Lake gold mineralization. The mapping confirmed earlier assumptions that gold mineralization in the Stormy Lake area is controlled primarily by gabbroic units that were involved in ductile deformation. However, follow-up work by Esso Minerals in the Long Lake area, specifically around the old Mirage shaft, did not outline economic mineralization. Future work in the belt should concentrate on specific investigations, such as structure, volcanic stratigraphy and igneous petrology in areas of good, i.e. burnt-over, exposure.

PROJECT 2.14: Mineral occurrence documentation - Rice Lake greenstone belt

INVESTIGATOR: P. Theyer

OBJECTIVES:

This program will provide an inventory of all known mineral occurrences of the Rice Lake greenstone belt, including data on the location, geology and mineral content. The information will provide an updated data base for the exploration of gold and other commodities in this area.

PROGRESS:

Mineral occurrence map and report for 52L/13 have been completed and are in press. Five additional reports are being prepared.

PRODUCTS:

Mineral Deposit Series Report No. 4, in press.

Mineral occurrence map and report for 52L/14 will be completed by April 1989. Maps and reports for the remainder of the Rice Lake greenstone belt (52M/3, 52M/4, 52L/11, 62F/1) are scheduled to be completed prior to March 1990.

FOLLOW-UP AND IMPLICATIONS:

The delineation of favourable base and precious metal geological environments will permit forcussed exploration in this greenstone belt. Details of deposit characteristics will permit an assessment of exploration methodologies in the area. Detailed geological and geochemical studies for selected occurrences will be undertaken in the future.

PROJECT 2.17: Platinum group element potential, Bird River area

INVESTIGATOR: P. Theyer

OBJECTIVES:

The objectives of this program are: (a) to delineate the distribution of platinum group elements in the Bird River Complex of southeastern Manitoba; and (b) to investigate the geological controls and geographical extent of platinum group element mineralization in this complex.

PROGRESS:

Known platinum group elements and gold occurrences in the Herb (Wekusko) Lake gold camp were sampled. Elevated concentrations of platinum group elements were detected in rocks of the Ferro gold mine. Similar results were obtained from rock samples of the Mirage gold occurrence in the Rice Lake greenstone belt.

Drill core of the Maskwa nickel-copper mine (Bird River Complex) was polished in preparation for an investigation of the petrography and petrochemistry of the host rocks.

PRODUCTS:

Report GR-30 in 1986 Report of Field Activities. A comprehensive report dealing with stratabound PGE in the Bird River Complex was submitted in February 1989 for publication in Mineralium Deposite.

FOLLOW-UP AND IMPLICATIONS:

Significant platinum group element concentrations have been established in both mafic and ultramafic rocks of the Bird River Complex. Detailed studies of platinum group element distribution and petrography of the ultramafic rocks in the Bird River Complex established the existence of a complex multi-layered stratigraphy and related PGE concentrations. These results provide guidelines for a systematic search for platinum group elements in layered ultramafic rock complexes.

PROJECT 2.28: Dimension stone resource assessment

INVESTIGATOR: B.E. Schmidtke

OBJECTIVES:

The purpose of this program is to evaluate the nature and extent of Manitoba's dimension and ornamental stone resources and to provide an inventory of materials with a potential for future development.

PROGRESS:

Granitic intrusions in southeast Manitoba and the Berens River area were sampled and documented for dimension stone potential. The sites with wide fracture spacing and attractive and homogeneous colours and textures were mapped and sampled with a cobra drill, and feather and wedge sets. Large polished slabs were made from these samples. Several promising sites were drilled to determine horizontal joint spacing and to obtain fresh, oriented samples for compression strength tests.

PRODUCTS:

Three B.Sc. theses were completed at the Geological Engineering Department of the University of Manitoba. Two theses were done on strength tests and one was done on dimension stone site evaluation. Industry representatives were taken on field trips of high potential sites.

Granite curbstone and pavingstone were installed in the core area of Winnipeg as demonstration projects to promote diverse applications of granite dimension stone. Those projects were completed in cooperation with the City of Winnipeg, Manitoba, Geological Services Branch and the Mineral Policy sector of the Federal government.

An Open File Report "The Tie Creek Land Use Conflict - a Geological Perspective" was published in 1988 and a final report "Dimension Stone in Southeast Manitoba" will be completed for publication in 1989.

Lecture on Dimension Stone uses was presented at annual Meeting with Industry in November 1988.

FOLLOW-UP AND IMPLICATIONS:

At present, two companies have applied for quarry permits on three sites. Two other companies have expressed interest in the same areas. These permits have not yet been granted due to land use conflicts.

GEOLOGICAL SURVEY OF CANADA

PROJECT C.2.1.2: Structural and gold alteration studies, Rice Lake region

INVESTIGATORS: K.H. Poulsen (GSC/MRD), D.E. Ames (GSC/MRD)

OBJECTIVES:

To examine regional and local features directly related to gold ore in the Rice Lake-Beresford Lake greenstone belt within an approximately 100 km2 map area centred on the San Antonio Mine. The study will assess: a) the relationship between gold-bearing structures and regional increments of deformation, b) recurring stratigraphic affiliations as a guide to ore, and c) the role of alteration (principally carbonatization) in the ore-forming process and its applicability as a guide to ore.

PROGRESS:

During the 1988 season four components of the project were advanced:

1) Rex Brommecker, supervised by K.H. Poulson and C.J. Hodgson, completed 1:2500 scale mapping in the vicinity of the Gunnar Mine. The mapping emphasized structural relationships which will be further analyzed as part of an M.Sc. thesis at Queen's University. A preliminary analysis of the data shows that at least three generations of structures are recorded in the rocks of this area.

D1: cleavage and local folds oriented subparallel to primary layering

D2: strongly developed northwest-striking cleavage axial planar to large upright folds

D3: crenulation and kink bands oriented approximately east-northeast.

2) L. Diamond, Carleton University, continued his study of fluid inclusions and carbonate alteration in the San Antonio and Gunnar areas. Vein quartz containing high proportions of CO2 was identified in the field using a technique of crushing fluid inclusions. Preliminary data show that this method may be a useful, practical tool for distinguishing veins formed in auriferous, CO2-rich environments from those that are not. L. Diamond also noted the temporal association of vein deposition and lamprophyre dyke emplacement at the Gunnar deposit: a single lamprophyre dyke cuts one quartz vein but in turn is cut by another vein.

3) A team of visiting scientists from the People's Republic of China participated in three weeks field work at the Central Manitoba and Oro Grande gold deposits. Mapping at 1:1000 scale revealed that the Wadhope gabbro is texturally and compositionally layered, and is subdivisible into basal equigranular mafic gabbro and upper granophyric and pegmatoid layers, with minor modal quartz; fractures, shear zones and veins are developed to the greatest extent in the upper layers.

4) The study of the structure and alteration at the San Antonio Mine is near completion. D.E. Ames successfully completed an M.Sc. thesis at Carleton University, under the supervision of J.M. Franklin and E. Froese, entitled "Stratigraphy and alteration of Gabbroic Rocks near the San Antonio Mine in the Rice Lake Area, Southeastern Manitoba". The thesis includes a 1:5000 scale geology map of the sequence hosting the gold deposit. An investigation of the variations in mineralogy and textures within the gabbro isolated the gold-bearing veins and associated alteration to the leucogabbroic portion of the sill. The presence of paragonite in the gold-related alteration has not been recognized in many other gold deposits to date. A plot of fCO2 vs. aK+ /H+ was useful in explaining the sequence of alteration assemblages associated with the deposit S. Lau and W. Brisbin of the University of Manitoba completed preliminary analysis of strain in rocks adjacent to the San Antonio deposit. The data show that the rocks of this area have undergone varying proportions of flattening and stretching, with the stretching direction parallel to the overall plunge of the San Antonio deposit.

PRODUCTS:

Report GSC-5 in 1988 Manitoba Report of Field Activities.

Completion of MSc. thesis by D.E. Ames.

Posters by D.E. Ames and R. Brommecker at 1988 Manitoba Meeting with Industry.

Paper in 1989 GSC Current Research.

Stratigraphic, structural and alteration studies from the Rice Lake region will be combined in a GSC report by March, 1990.

FOLLOW-UP AND IMPLICATIONS:

R. Brommecker will continue detailed mapping around gold deposits in the Beresford Lake region as a GSC A-base project.

The present level of study has allowed K. Poulson to postulate an environment of gold deposition similar to the Norseman-Wiluma Belt in Western Australia. D. Ames will complete her M.Sc. thesis in the upcoming fiscal year, and the various components of the project will be compiled into a report edited by K. Poulsen.

The studies carried out under this project will allow for a greater understanding of the relationship of gold deposits to regional tectonic events, and allow explorationists to further define potential target areas within the Superior Province.

PROJECT C.2.2.3: Falcon Lake intrusive complex

INVESTIGATORS: N.M. Halden (U. of M.), W.C. Brisbin (U. of Manitoba), R.F.J. Scoates (GSC/MRD)

OBJECTIVES:

To investigate the petrology, stratigraphy, tectonic setting and precious metal mineralization of the Falcon Lake Intrusive Complex (FLIC). The stock hosts significant gold mineralization and an unconfirmed occurrence of platinum group elements.

PROGRESS:

The following is a description of the progress made on the third and last portion of a study of the metallogeny of the Falcon Lake Intrusive Complex, the first two being on the internal stratigraphy and the gold mineralization associated with the complex. The relationship between small, zoned, late kinematic intrusions and gold mineralization is of interest with respect to pos-

sibility of the gold being magmatic. This study is part of a program by the GSC, which includes the Star Lake and Phantom Lake igneous complexes in Saskatchewan.

Major and trace element geochemical analysis has been completed on 151 whole-rock specimens from the Falcon Lake complex. REE analyses have been obtained on 15 samples representative of gabbro to quartz monzonite compositions. Electron microprobe analyses are also available for plagioclase, pyroxene, amphibolite, K-feldspar and oxides from the major intrusive phases.

The fractionation history of the complex, although reflecting a single liquid line for descent of the majority of its later history, was probably more complex during the earlier phases of gabbro intrusion. The An contents of plagioclase 2 and 4 vary between 60 and 69, for gabbros 1 and 3 they vary between 31 and 49, there being an obvious compositional hiatus between 50 and 60. Whole rock trace element compositions for gabbros 1 and 2 would suggest that they are more primitive than gabbros 3 and 4. It is possible that there were two main magmatic pulses, both gabbroic in composition, that underwent similar fractionation histories.

Gabbro 2 tends to be anomalous in composition when compared with other gabbroic phases. Some rocks contain up to 4 wt.% K_2O and Sr levels can be as high as 1700 ppm. Although they could not be considered truly "highly potassic", many of the analyses have MgO contents in excess of 3 wt.% and K_2O/Na_2O ratios in excess of 1.

Analyses of the mafic phases reveal that they are often zones, having Ca-pyroxene cores rimmed with calcic amphibole. This would suggest that at least some of the gabbro had fractionated an early pyroxene. The origin of the later amphibole overgrowth could be related to greenschist facies metamorphism; the possibility, however, that it could represent fluctuations of PH_2O within the magma chamber cannot be discounted at this stage.

Petrographic studies have revealed some unusual mineralogical relationships. One such example can be observed at the contact between anorthositic layers and oxide layers in some of the later gabbro phases. It takes the form of oxide (probably magnetite) and apatite layers in contact with the anorthositic layers, adjacent to the apatite layers. There are skeletal growths of radiating amphibole. This texture suggests an unusual reaction that may have taken place within the magma during crystallization; this will be the subject of further microprobe studies.

PRODUCTS:

Report GSC-7 in 1988 Manitoba Report of Field Activities.

W. Mandziuk's MSc. thesis on the internal stratigraphy of the sill

Paper in Canadian Mineralogist on sill stratigraphy.

One M.Sc. has been completed (Mandziuk, U. of M.) and two more are in the final stages of preparation. Results will be combined and open filed by September, 1989.

FOLLOW-UP AND IMPLICATIONS:

Results have discounted the presence of PGE mineralization, and has refined the relationship between igneous activity and gold deposition within, and marginal to, the complex.

PROJECT C.2.2.5: Bird River Sill

INVESTIGATORS: R.F.J. Scoates (GSC/MRD), O.R. Eckstrand (GSC/MRD), J.M. Duke (GSC/MRD), B.L. Williamson (GSC/MRD)

OBJECTIVES:

The project is designed to document the nature, distribution and origin of chromitite layers and subeconomic concentrations of platinum group element-bearing rocks in the Ultramafic Series of the Bird River Sill. Detailed maps, at a variety of scales, will illustrate significant elements of the sill stratigraphy.

PROGRESS:

Field work on the Bird River Sill was devoted to completing detailed mapping of the Chrome Property area. These maps will be open filed at 1:100, 1:200, and 1:1000 scales by September, 1989.

Sampling was dedicated to completing a sequence of stratigraphically related samples through both the Ultramafic and Mafic Series. Petrological and geochemical investigations are proceeding.

PRODUCTS:

Report GSC-11 in 1988 Manitoba Report of Field Activities.

Detailed maps and reports will be published as three open files by September, 1989.

FOLLOW-UP AND IMPLICATIONS:

The detailed mapping of the sill has led to a refinement of the Ultramafic Series stratigraphy,including recognition of a new zone of chromitite layers, and the effects of cross-faulting (which will be important in any future exploitation of potential stratabound chromite or PGE deposits), and has uncovered numerous examples of outcrop-scale synmagmatic disruptive features that may control concentration of PGE mineralization.

DISTRICT IV: THOMPSON

Summary:

MANITOBA GEOLOGICAL SERVICES BRANCH:

U-Pb studies in the Thompson belt and northwest Superior Province, conducted in cooperation with the Royal Ontario Museum, have defined two ages of Archean terrains in the Nickel Belt as well as clearly defined Hudsonian reworking at 1809 Ma, and intrusion by younger granites at 1726 Ma.

Detailed mapping of the Pipe Pit generated a highly refined supracrustal stratigraphy for the Ospwagan Group permitting correlation of this sequence with those at Ospwagan Lake, the Manasan Quarry, and Thompson Open Pit, as well as, reinterpretation of the structures and structural sequence in this complexly deformed terrain.

As part of a cooperative program with the Department of Geological Sciences, University of Manitoba, new major and trace element analyses of metavolcanic rocks from Moak and Assean lakes were compared with previous data from Ospwagan Lake and Fox River. The Moak and Assean lavas show some similarities, both being consistent with basin-margin settings, and with derivation from a relatively primitive mantle. Relatively high K and Rb values are explained as a result of seafloor alteration. Assean and Ospwagan rocks tend to straddle the boundary between calc-alkali basalts and island-arc tholeiites whereas those from the Fox River belt and Moak Lake appear restricted to the island-arc tholeiite field.

In the central Cross Lake area a limited program of site checks, and correlation studies completed the 1:20 000 mapping of supracrustal rocks. A pilot study of the thermotectonic evolution of the Cross Lake area was initiated by the Free University of Amsterdam. Two granitoid units were sampled for geochronological studies at the Royal Ontario Museum.

A grassroots exploration program was initiated by Utah Mines at Cross Lake following MDA work on the Pipestone Lake titanium- and vanadium-bearing anorthositic, gabbro. However, work has subsequently been suspended because of native land claims in the region.

The Cross Lake community (band council) has expressed significant interest in the geological investigations being undertaken in the region and has independently mounted ground and airborne surveys and drilling programs funded under the Northern Development Agreement.

GEOLOGICAL SURVEY OF CANADA

In the Thompson region, two structural studies have been completed, a regional study by Frank Fueten (U. of Toronto) and a deposit-centered study by Wolter Bleeker. A cooperative study between W. Bleeker and J. Macek (MGSB) has resulted in the completion of mapping of the Pipe No. 2 and Thompson open pit nickel deposits, with a better understanding of the relationship of the deposits with the host Ospwagan Group.

PROJECT DESCRIPTIONS

MANITOBA GEOLOGICAL SERVICES BRANCH

PROJECT 1.11.1 & 1.11.2: Cross Lake, geological mapping and regional evaluation

INVESTIGATORS: M.T. Corkery and H.D.M. Cameron, P.G. Lenton

OBJECTIVES:

The objectives of this program are to stimulate and direct mineral exploration in the Cross Lake-Thompson region, and to provide a broader mineral base for the Thompson region by establishing an updated geological data base for supracrustal and ultramafic-anorthositic rocks that contain occurrences of strategic, base and precious metals.

PROGRESS:

Mapping in 1988 was complicated by a very low water level on Cross Lake that greatly increased available exposure while restricting access to critical problem areas. The low water level exposed an area critical to unravelling the relationship of sediments that had previously been interpreted as older Pipestone Lake Group sediments. Current investigations indicate the sediments consitute a series of fault slices of younger Cross Lake Group rocks tectonically interlayered with Pipestone Lake Group. The abundant exposures contributed geological data relevant to solutions in several problem areas and additional detail over much of the map area. Restricted access left some problem areas unchecked. A short field season in the 1989 season will complete the data collection. Two additional units were sampled and submitted to D. Davis (ROM) for U/Pb geochronology.

PRODUCTS:

Preliminary report in Report of Field Activities 1988.

Scientific paper on "Geochronological constraints on the evolution of the Cross Lake greenstone belt", co-authored with J. Davis, ROM, will be submitted to Canadian Journal of Earth Sciences in 1989/90.

FOLLOW-UP AND IMPLICATIONS:

Identification of several additional tourmaline-arsenopyrite alteration zones associated with elevated gold values may broaden the exploration efforts on this type of alteration. A new private sector exploration program have been moumted as a direct result of this mapping program.

Final report on Cross Lake (1991) will help target mineral exploration into the most favourable areas.

Open File report on Ti-V mineralization (1989/90) will establish geological criteria for the economic evaluation of this deposit.

PROJECT 1.11.3: Thompson belt supracrustal rock investigations

INVESTIGATOR: J.J. Macek

OBJECTIVES:

To characterize lithologies of supracrustal rocks in areas of good exposure such as Thompson Pit, Pipe Pit, etc. in support of other investigations in the Thompson belt (Projects 1.16, 1.16.2, C.1.1.4., C.1.1.5, C.2.26) and for compilation purposes.

PROGRESS:

Geological investigations during the 1988 field season established the detailed stratigraphy of the Ospwagan Group with distinct local and regional markers and the stratigraphic location of the major mineralizations in the Thompson belt.

Preliminary map (1:400) of Pipe Pit Mine and Thompson pit (1:1200) are completed and will serve for preparation of coloured maps at 1:1000 scale. 250 samples selected for chemical analyses and for petrographic investigations. Microscopic study is in progress.

PRODUCTS:

Preliminary map of Pipe Pit

Progress report in Report of Field Activities 1988.

Open File Report with maps of Pipe and Thompson open pits to be completed 1989/90.

FOLLOW-UP AND IMPLICATIONS:

The detailed stratigraphy of the Ospwagan Group allows reliable interpretation of the regional structure that in turn has direct implications for targetting mineral exploration. Localities at Setting Lake, Ospwagan Lake and Mystery Lake will be revisited this coming summer in order to complete geological information for a report on the Ospwagan Group.

PROJECT 1.12: Field support for northern Superior U-Pb geochronology program

INVESTIGATORS: W. Weber in cooperation with T. Krogh, L. Heaman and N. Machado (Royal Ontario Museum), and T. Gordon (GSC)

OBJECTIVES:

To provide a geological framework, collect and provide rock samples for U-Pb isotope investigations and to contribute to the geological evaluation of the U-Pb ages determined in the laboratories of the Royal Ontario Museum. Analyses are funded by the GSC.

PROGRESS:

Ten U-Pb ages from the Cross Lake area and one U-Pb age from the Thompson belt.

Evaluation of data and report preparation.

PRODUCTS:

Two progress reports in Report of Field Activities 1988

One Summary Report.

FOLLOW-UP AND IMPLICATIONS:

This program permits, for the first time, the establishment of a chronological framework for the development of the N.W. Superior Province, the Thompson belt and the contained nickel mineralization, as well as, correlations with precise age data and processes in the adjacent Churchill Province. This framework will be incorporated into the structural evolution of the Thompson belt determined by another MDA project. This will allow for the determination of processes related to mineralization, and ultimately the better understanding of the Thompson-type ore deposits and the constraints and guidelines in the search for new deposits.

PROJECT 1.15: Project management

INVESTIGATOR: W. Weber

OBJECTIVES:

To supervise field projects and conduct field demonstrations for potential MDA contributors.

Participate in MDA related field demonstrations.

PROGRESS:

Assisted in organizing Workshop and field trips of "Friends of the Nickel Belt" in June, 1988, with participation of industry (Inco, Inco Gold and Falconbridge).

Participated in NATO Workshop and field trips (9 days) in Killarny, Ontario, dealing with cross-sections of continental crust.

T. Corkery attended Ontario Open House in December 1988 representing MGSB.

E. Nielsen attended GSC Open House in January 1989 representing MGSB.

PRODUCTS:

Organization of Field Workshop for "Friends of the Nickel Belt".

Oral presentation at NATO-sponsored workshop.

FOLLOW-UP AND IMPLICATIONS:

Project management activities initiated and coordinated new MDA projects, facilitated cooperation of activities, and discussions and dissemination of data among professionals from government, universities and industry. Numerous field conferences and symposia were organized to elaborate on new discoveries and encourge active participation in, and feedback from, industry on present MDA activities and input for future programming.

Annual meetings and field trips organized by MGSB and industry personnel under the informal umbrella of "Friends of the Nickel belt" have resulted in dissemination and discussion of data in the field, improved

cooperation and coordination of various disciplines, and a better understanding of the Manitoba Nickel belt. Inco and Falconbridge geologists are in constant contact with MDA geologists during their exploration efforts. Thus, scientific results are immediately tested in new areas and translated into economic realities.

PROJECT 1.16: Rubidium-strontium isotopic studies of selected rock units in northern Manitoba

INVESTIGATOR: G.S. Clark (University of Manitoba)

OBJECTIVES:

The objective of this project is to determine rubidium and strontium isotopic abundances for igneous and metamorphic rocks in the Cross Lake area and in the Superior-Churchill boundary area near Split Lake. The isotopic ages will be used to determine the age of intrusion of the Molson dykes in the northern Churchill Province and the age of formation of basement gneisses and younger granitic plutons in the Split Lake area. The results will permit a more orderly treatment of crust-forming events and crustal evolution. The work will also be used to relate the timing of ore-forming events to crustal evolution and development.

PROGRESS:

Project completed.

PRODUCTS:

N.A.

FOLLOW-UP AND IMPLICATIONS:

Results indicate that the Rb-Sr method is not suited for dating contact metamorphism but has some potential for dating ductile deformation. Future projects in N.W. Superior Province could determine the degree of involvement of the crust in tectonic stacking by Trans-Hudsonian collision and the distinction between Hudsonian and Archean zones of ductile deformation that would be important for shear zone related gold mineralization and tracing of Archean structures.

PROJECT 1.16.2: Thompson belt geochemistry

INVESTIGATOR: N.M. Halden (U. of Manitoba)

OBJECTIVES:

To provide geochemical fingerprinting of mafic and ultramafic rocks in Thompson belt supracrustal belts.

PROGRESS:

Work and report completed.

Analysis include major, trace and REE analyses.

PRODUCTS:

Final report in Report of Field Activities 1988.

Scientific paper submitted to Canadian Journal of Earth Sciences, February, 1989.

FOLLOW-UP AND IMPLICATIONS:

Results of this study suggest that the most likely tectonic setting of Churchill-Superior boundary zone mafic magmatic rocks is in a margin basin or back-arc. This would support a model in which boundary zone mafic magmas derived from Trans-Hudson oceanic magmas and the possibility that nickelliferous deposits may also occur in the Churchill Province, associated with early Hudsonian mafic magmatic rocks predating the arc development. A typical example might be the Namew Lake deposit. Further work on that deposit is required in the future.

PROJECT 5.7: Thompson-Pikwitonei compilation

INVESTIGATORS: W. Weber, J.J. Macek, W.D. McRitchie and H.V. Zwanzig

OBJECTIVES:

To provide a comprehensive and up-to-date regional geological framework fat the scale of 1:250 000 or identification of mineral exploration targets.

PROGRESS:

NTS 63N printed and 630 compiled.

PRODUCTS:

63N printed.

FOLLOW-UP AND IMPLICATIONS:

Map 63N provides an up-to-date geological map of a region that over the last 30 years has seen little new compiled data, except for the Flin Flon belt.

This is of particular interest to gold and base metal explorationists in the southern margin of the Kisseynew belt. The maps include the work compiled during the 1988 field season. This was possible using a new quick technique of pantone colour film directly applied to a base and then screened, colour separated and printed, instead of the older method of peelcoats for individual units, which then are combined into colour negatives.

Publication of NTS sheet 630.

GEOLOGICAL SURVEY OF CANADA

PROJECT C.1.1.4: U/Pb geochronology, N.W. Superior Province

INVESTIGATORS: T. Krogh (ROM) and T.M. Gordon (GSC/LCSD)

OBJECTIVES:

To select samples for U/Pb geochronological studies from the Pikwitonei granulite domain, Thompson belt and Cross Lake region, in support of concurrent work being carried out in these regions by the federal and provincial surveys. This work is carried out under contract from the federal government to the Royal Ontario Museum. The age dating will assist in further con-

tario Museum. The age dating will assist in further constraining the timing of deformation and metamorphism in the Thompson Mobile Belt, thereby defining the structural evolution of the Superior plate margin.

PROGRESS:

U-Pb data are in the process of being finalized and reports and papers are being prepared.

A U-Pb isotope study of monotypic zicrons and titanite of a migmatite near Sasagiu Rapids (Machado, submitted) indicates the formation of the paleosome protolith at 3038+/- 6 Ma, followed by metamorphism at 1809+/-14 Ma and 1737+/- 5 Ma. At 1726+/- 12 Ma the paleosome was intruded by granitic neosome containing inherited zircons dated at 2655+/- 10 Ma. The presence of gneisses older than 3.0 Ga not affected by late Archean metamorphism (2.6-2.7 Ga) which are associated with rocks containing "Pikwitonei"-type 2.64-2.7 Ga zircons indicates that two Archean terranes of different histories were involved in the evolution of the belt. The age 1726+/- 12 Ma for granite intrusion is the youngest so far measured and seems to be restricted to the southern half of the Thompson belt.

During the 1988 field season a felsic volcanic flow was discovered in the Ospwagan Group at Ospwagan Lake by W. Bleeker and J. Macek thanks to low water levels. A U-Pb zircon age of this flow, to be determined this winter, should finally date the Thompson belt Proterozoic supracrustal rocks and determine whether the Ospwagan Group is older than Molson dyke and Fox River supracrustals, as suggested by Macek (1987) based on contact relations observed last year in the Pipe Pit. U-Pb results from the Thompson belt will be published in the GAC Special Paper on Trans-Hudson Orogen (Machado, in prep.).

PRODUCTS:

Paper in GAC Special Volume on the Trans-Hudson Orogen.

Paper submitted to CJES

FOLLOW-UP AND IMPLICATIONS:

W. Bleeker will complete several U/Pb zircon analyses of samples from the Ospwagan Group.

PROJECT C.1.1.5: Structural studies in the Thompson Belt

INVESTIGATOR: F. Fueten (U. of Toronto)

OBJECTIVES:

To determine direction and timing of various structural blocks bordering the Nelson Front, by studying major shear zones within the Thompson belt.

PROGRESS:

Frank Fueten completed field work in the Paint Lake-Wintering Lake area. A doctoral thesis dealing with the deformation in the granitoid gneisses is being completed under R. Robin at the University of Toronto. E. Froese is the GSC project supervisor.

PRODUCTS:

Completion of Ph.D. thesis, spring 1989

Paper accepted by CJES

FOLLOW-UP AND IMPLICATIONS:

The nature of the boundary relationship between the Superior and Churchill provinces has strong implications for the setting of nickel mineralization in the former and gold mineralization in the latter. Data will add to the understanding of Precambrian styles of tectonism.

PROJECT C.2.2.6: Thompson Nickel Belt

INVESTIGATORS: W. Bleeker (U.N.B.), C. van Staal (GSC/LSCD) and O.R. Eckstrand (GSC/MRD)

OBJECTIVES:

To study the structure and related geology of the nickel deposits at the Thompson Mine with the objective of determining their structural and metamorphic history and, if possible, defining new exploration targets. This will involve mapping of the new open pit and underground workings, and logging of drill core.

PROGRESS:

Aphebian metasediments and metavolcanics of the Thompson Nickel Belt are collectively known as Ospwagan Group (Scoates et al., 1977). All major Ni-sulphide deposits of this world-class mineral belt occur within or associated with ultramafic bodies contained within complexly deformed Ospwagan Group supracrustals. The commonly differentiated dunite-pyroxenite bodies originated probably as subvolcanic sills (Peredery et al., 1982). Despite the fact that the orebodies and associated ultramafic parent rocks generally are stratabound (a detailed Ospwagan Group stratigraphy would thus have important bearing on the identification of favourable horizons, the genesis of the sulphide orebodies and the elucidation of the large-scale geometry of this complex belt) only a generalized outline of the Ospwagan Group stratigraphy has been published (Peredery et al., 1982).

Outcrops in and around the presently producing Thompson Open Pit and the exhausted Pipe II Open Pit (see Fig. GS21-2 for locations) provide the most complete exposures of Ospwagan Group supracrustals and associated orebodies. Detailed structural and lithological mapping of both pits has led to the recognition of a more refined supracrustal stratigraphy (Bleeker and Macek, in prep.), an outline of which will be presented below. The supracrustal sequence is best exposed and most complete at Pipe II Open Pit, whereas the sequence is more condensed and/or structurally disrupted elsewhere. The Pipe II section is therefore described as the type section against which other localities (Ospwagan Lake, Manasan Quarry, Thompson Mine, etc.) can be correlated. At Ospwagan Lake a several metre wide band of quartz-phyric rhyolite is exposed, the first reported occurrence of felsic volcanics in the

Thompson Nickel Belt; these rocks may finally allow precise U-Pb dating of the Ospwagan Group.

The Thompson Open Pit has been mapped at 1:1200 scale. This map with accompanying description, will soon be available as a Geological Survey of Canada open file (W. Bleeker, in prep.). This summer, mapping of the Pipe II Open Pit was completed, using low altitude aerial photographs (Macek, 1987). Eight sheets (1:400) cover Pipe II Open Pit and surrounding outcrops (Preliminary Maps 1988T-1 to -8; Bleeker and Macek, 1988). It is intended to finalize them as coloured maps with accompanying descriptions.

PRODUCTS:

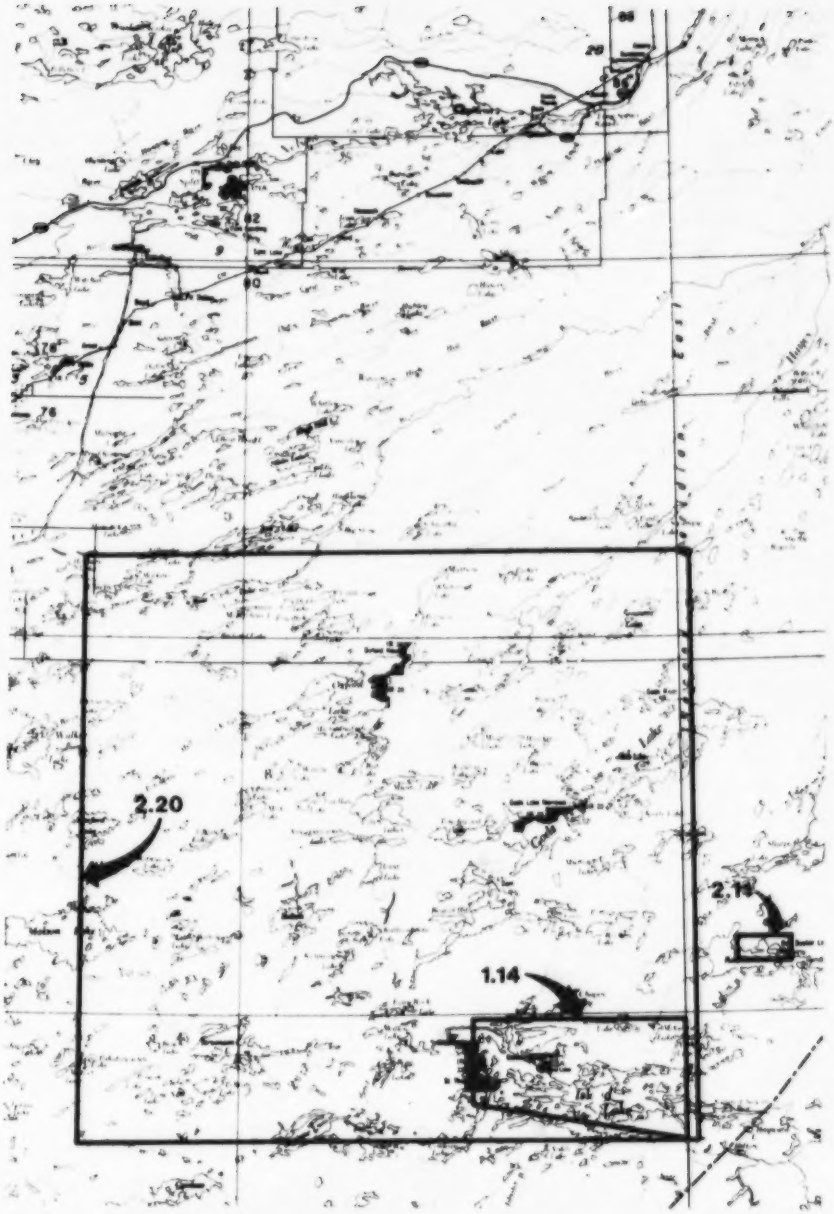
Report GS-21 in 1988 Manitoba Report of Field Activities.

Provincial open file with J. Macek on the geolog, of the Pipe No. 2 open pit.

Paper in GAC Special Volume on the "Geology of the Early Proterozoic Trans-Hudson Orogen".

FOLLOW-UP AND IMPLICATIONS:

Joint publication of the geology of the Thompson and Pipe No. 2 open pit geology by W. Bleeker and J. Macek. W. Bleeker will open file (GSC) 1:1200 scale map of the Thompson open pit with accompanying descriptions. W. Bleecker's Ph.D. thesis will be completed January 1990. The results of detailed and regional mapping will allow the companies to differentiate between barren and economic massive sulphide occurrences.



DISTRICT V: NORTHERN SUPERIOR

1.14 Northern Superior Greenstones, geological mapping
2.20 Rare-element-enriched pegmatite evaluation

Figure 12: Provincial Sector 'A' projects 1988 - District V: Northern Superior.

DISTRICT V. NORTHWEST SUPERIOR PROVINCE, GODS - ISLAND LAKES REGION

Summary:

MANITOBA GEOLOGICAL SERVICES BRANCH:

Detailed sampling of the late Archean Magill Lake Granite and associated pegmatites continued, and several new lepidolite-bearing pegmatites were identified east of McLaughlin Lake.

Petalite occurrences on Red Sucker Lake were remapped in detail and sampled to determine their suitability as a raw material for ceramics.

Enquiries received by Branch geologists indicated continued and significant interest in the "undiscovered" carbonatite potential of this region. Westmin Resources have mounted an extensive exploration program in the Utik Lake region based in part on geological reports and maps released in 1974. An intensive drilling program continues in the Little Stull Lake region with significant gold values returned after over 14 000 m of drilling by Tanqueray Resources Ltd, Estaurum Mines Ltd. and Westmin.

GEOLOGICAL SURVEY OF CANADA:

In northeastern Manitoba, a study of the internal stratigraphy and PGE potential of the Fox River Sill was completed, with the results contained in a M.Sc. thesis completed by Pamela Schwann, and in a paper in Economic Geology. The regional geochemical lake sediment and water survey was open filed for the Gods Lake-Oxford Lake region. Field checking was completed for the 1:250 000 scale surficial geology maps that are part of a series of the GSC 'North of 53°' series that will be published by the end of summer, 1989.

PROJECT DESCRIPTIONS

GEOLOGICAL SERVICES BRANCH

PROJECT 1.14: Northern Superior greenstones geological mapping - Island Lake

INVESTIGATORS: H.P. Gilbert and W. Weber

OBJECTIVES:

The objective is to stimulate and direct exploration for gold and base metals east of Thompson by providing an updated geological data base in areas with gold and base metal occurrences and past mines, and where companies are actively engaged in exploration.

PROGRESS:

Modal analyses of granitoid rocks.

PRODUCTS:

Final report and maps after completion of Tartan Lake, Project 1.5.5.

FOLLOW-UP AND IMPLICATIONS:

Completion of the project has been delayed due to reassignment of the senior author (P. Gilbert) to the Tartan Lake project, and other work pending.

Results of Preliminary Maps supplemented by personal advice, etc. have been applied to ongoing exploration in the Bigstone and Knight Lakes area.

PROJECT 2.20: Rare-element-enriched pegmatite evaluation

INVESTIGATORS: P. Cerny (U. of Manitoba) and G.H. Gale

OBJECTIVES:

This project is designed to investigate and document occurrences of rare-element-enriched pegmatites in north-central Manitoba and to establish techniques for exploration and evaluation.

PROGRESS:

Geological mapping in the vicinity of the Magill Lake Granite and sampling of pegmatites in the Red Sucker Lake area have been completed. Laboratory studies have been completed. The field work for this project has been completed.

PRODUCTS:

Report GS-25 in the 1988 Reports of Field Activities.

Undergraduate thesis by R. Elby (1988) - A structural and petrofabric study of sheared pegmatite dykes, Red Cross Lake, Manitoba.

Four outside publications and public lectures were prepared in 1988 utilizing information obtained during this project by P. Cerny and colleagues.

A final report for this project is in preparation and should be completed by the end of May 1989.

FOLLOW-UP AND IMPLICATIONS:

The investigation of rare-element-enriched pegmatites in north-central Manitoba will increase the database for the exploration of strategic metals, and will enhance methods to aid in the evaluation of their economic potential.

GEOLOGICAL SURVEY OF CANADA

PROJECT C.2.2.4: Fox River Sill

INVESTIGATORS: R.F.J. Scoates (GSC/MRD), O.R. Eckstrand (GSC/MRD) and P.L. Schwann (Carleton U.)

OBJECTIVES:

The project is designed to contribute to the understanding of magmatic processes that give rise to concentrations of platinum group-bearing sulphides in certain stratigraphic horizons of the Fox River Sill. Cryptic

variations of silicate mineral compositions, distribution and interelement association of PGE's and detailed igneous stratigraphic studies will contribute to assessing the potential of this intrusion to host economic concentrations of PGE's.

PROGRESS:

Research on the petrology, geochemistry, stratigraphy and platinum-group element (PGE) mineralization of the upper 25 m of the Lower Central Layered Zone (LCLZ) and the lower 600 m of the Upper Central Layered Zone (UCLZ) stratigraphy of the Fox River Sill (FRS) was continued by Pamela Schwann, who is completing her M.Sc. thesis at Carleton University under the supervision of R.FJ.Scoates (GSC) and D.H. Watkinson (Carleton University). Three intervals, the Lower Middle and Upper Mineralized intervals, contain PGE mineralization (PGE 100 ppb) that is predominantly associated with sulphide-bearing pyroxenites. The Lower interval is 80 m thick and consists of finely interlayered rhythmic sequences of thin dunite and peridotite layers capped by thicker olivine clinopyroxenite layers. The Middle interval is 50 m thick and occurs in a sequence of cyclic units composed of thin peridotite layers overlain by thick, sulphide-bearing, medium to coarse-grained olivine clinopyroxenites. Cyclic units are not always completely developed. The Upper interval occurs within sulphide-bearing hornblende-olivine pyroxenite. The pyroxenite is 9 m thick with PGE mineralization contained within the coarse grained upper 5 m.

Statistical analyses of PGE and elements of base metal sulphide (BMS) affinity (Cu, Ni, S) and As, Te, Sb, and Bi were used to infer the geochemical association of PGE. There is a moderately positive correlation among PGE and BMS in the 89 mineralized samples, notably concentrations and absolute S abundances are poorly correlated. There is no correlation between PGE and As, Te, Sb, Bi nor Cr.

S isotopes of 11 mineralized samples within the 600 m study interval yielded heavy S isotope values. A follow-up isotope study initiated this past spring by O.R. Eckstrand (GSC) and carried out by the University of Calgary participants R. Krouse and I.L. Grinenko (USSR) confirmed the heavy nature of the S isotope signature of the Fox River Sill. Values within the UCLZ 600 m study interval range from +0.7 - +12.4 per mil, generally becoming increasingly lighter with increasingly stratigraphic height. LCLZ samples have the heaviest S signature (+16 - +18 per mil).

P.L. Schwann completed her M.Sc. thesis on the stratigraphy and PGE mineralization of the Fox River Sill.

PRODUCTS:

Report GSC-10 in 1988 Manitoba Report of Field Activities.

MSc thesis by P.L. Schwann.

GSC 1989 Current Research Paper.

Results of the Fox River study will be open filed by September 1989, followed by formal GSC paper.

FOLLOW-UP AND IMPLICATIONS

This stratigraphic and lithogeochemical study is significant in advancing the understanding of the relationship between PGE's and igneous proceses.

PROJECT C.5.1.1: Surficial geology atlas compilation, Manitoba - north of 52°

INVESTIGATORS: M. Clarke (GSC/TS) and R.N.W. DiLabio (GSC/TS)

OBJECTIVES:

To produce an atlas showing: 1) surficial geology, 2) till geochemistry, and 3) granular material resources. Coverage to start in northeast corner of area and proceed clockwise using data from Dredge, Kaszycki, Klassen, DiLabio (GSC) and Nielsen (MGSB). Gaps in coverage to be filled in by airphoto interpretation and a limited amount of field checking. Legends, other specifications, style of presentation to be determined by same personnel.

PROGRESS:

Current status of the project includes the recent publication at 1:250 000 scale of surficial geology maps of Stull Lake (53K), Oxford House (53L), and Norway House (63H). These maps include an inset map of potential aggregate resources. Printing of maps at similar scale for Gods River (63A) is expected to be completed by March 1989. Furthermore, mapping and drafting of six additional maps: Deer Lake (53D), Kaskattama River-Black Duck River-Cape Tatnam (54B,A,G), Sturgeon Lake-Thorne River (53O,J), Swan Lake (63C), The Pas (63F), and Cormorant Lake (63K) has been completed and publication is expected before July 1989.

PROJECTS:

See PROGRESS

FOLLOW-UP AND IMPLICATIONS:

See PROGRESS

DISTRICT VI - MANITOBA GENERAL

Summary:

MANITOBA GEOLOGICAL SERVICES BRANCH:

In the Phanerozoic sector of the Province five separate projects included: detailed drilling of the Winnipegosis reef at The Bluff on Dawson Bay; a regional Silurian correlation project; regional outcrop mapping in the Moose Lake area; drilling to basement near North Moose Lake, drilling and mapping north of Grand Rapids; and drilling for the Water Resources Branch in the City of Winnipeg to provide additional information on the Upper Red River aquifer. Fourteen core holes were drilled for a total of 1260 m.

The Interlake region of Manitoba exhibits many features that mirror the geological setting of Mississippi Valley-type lead-zinc mineralization in the mid-continent of the United States. Earlier work in Manitoba's Paleozoic formations, stimulated by the discovery of galena float, has focussed principally on the possibility that heavy minerals might be detected in basal till profiles or that anomalous metal concentrations might be encountered in drill core from the region. More recently greater emphasis has been directed toward examination of the extensive outcrop belt north of latitude 53°.

Documentation of Karst features in the Grand Rapids Uplands resulted in the discovery of several new caves bringing the total to 45. At least 20 others are known or reported from the southern Interlake and others have been reported in the gypsum deposits at Gypsumville.

Examination of Silurian outcrop and drill core data in the Interlake confirmed the usefulness of sand and clay zones in correlating between the Hodgson and Grand Rapids areas. The new information may resolve the "Inwood problem" in that more definite correlations now appear possible equating the Lower Inwood of the southern area with part of the Fisher Branch Formation, and the Upper Inwood Formation to the upper part of the Moose Lake Formation of the northern area. Although numerous new fossil localities have been discovered and sampled it is too early at this time to comment on their potential as unique stratigraphic markers.

Although the principal rationale for the stratigraphic mapping program is to define the regional framework of Paleozoic and Mesozoic formations in the Province, several private sector initiatives have been spawned from, or made extensive use of, the data base generated by this program.

In recent years these have included: discovery of petroleum in Saskatchewan by Home Oil using concepts developed in the Manitoba outcrop belt; exploration for high calcium limestone at Dawson Bay; evaluation of subsurface waste disposal sites by Manitoba Hydro; and a base metal exploration program centered on the Winnipegosis reefs of the Dawson Bay area.

PROJECT DESCRIPTIONS

MANITOBA GEOLOGICAL SERVICES BRANCH

PROJECT 2.21: Lead-zinc potential of carbonate rocks in southern Manitoba

INVESTIGATOR: G.H. Gale

OBJECTIVES:

To identify the source of galena float discovered in Manitoba and to determine the potential for occurrence of lead and zinc in carbonate rocks of Manitoba.

PROGRESS:

Open File report is on hold awaiting assistance with computer analysis of data file. Field studies extended the known extent of karst landforms in the Interlake and generated new information on the nature, orientation and degree of paleokarst in Paleozoic carbonates.

PRODUCTS:

None in 1988-89.

FOLLOW-UP AND IMPLICATIONS:

Data analysis has been started. Report completion is anticipated before March 1990.

PROJECT 2.26: Industrial minerals mapping, Duck Mountain

INVESTIGATOR: B.E. Schmidtke

OBJECTIVES:

The purpose of this program is to document the nature, extent and reserves of all industrial mineral occurrences in the Duck Mountain map area NTS 62N. Occurrences of dolomite, glauconite, silica sand, lignite and bentonite will be examined and sampled, and the geological setting of the occurrences described in detail.

PROGRESS:

Known industrial mineral occurrences in the north half of NTS map sheet 62N were examined and sampled. Several peat bogs with a potential for fuel or horticultural peat were sampled.

PRODUCTS:

Preliminary report GS-41 in Report of Field Activities, 1986, describes the findings in NTS 62N map sheet area.

FOLLOW-UP AND IMPLICATIONS:

Completion of this project has been delayed in order to concentrate on the dimension stone resource assessment.

PROJECT 4.1.2: Lead-zinc potential of carbonate rocks in southern Manitoba

INVESTIGATOR: E. Nielsen

OBJECTIVES:

To identify the source of galena float discovered in Manitoba and to determine the potential for occurrence of lead and zinc in carbonate rocks of Manitoba using geochemistry of the less than two micron fraction of overburden samples.

PROGRESS:

The geochemistry of the less than two micron fraction of 573 overburden samples collected from 372 backhoe pits in southern Manitoba is complete. Pebble counts and grain size analysis on selected samples is nearing completion.

Geochemical analyses have not identified any anomalous base metal occurrences in the area. The geochemistry of the tills shows a close correspondence with the bedrock in all area.

PRODUCTS:

Geological Paper GP87-1 detailing the results of the geochemistry and the preliminary Quaternary stratigraphy of the area should be available for release late in 1988.

FOLLOW-UP AND IMPLICATIONS:

The study has produced a stratigraphy of Quaternary sediments for the Manitoba Interlake and West Lake areas using field relations and geochemistry of the sediments. The association of galena float with Komarno till in the Balmoral area suggests it may have been derived from the Devonian outcrop belt.

No further follow-up is planned at this time.

PROJECT 5.12: Mineral deposit compilations

INVESTIGATOR: G.H. Gale

OBJECTIVES:

To provide an organized data base for mineral deposit information on 1:50 000 scale base maps.

PROGRESS:

A drafting technician has used the Autocad system to provide diagrams for Mineral Deposit Reports 2, 3, 4 and 5 (NTS area 63K/13SW, 63K/13N, 63K/16, and 53L/14N) and is currently preparing material for NTS area 63K/9. A Geologist I has been engaged in overseeing the preparation of the mineral deposit maps for Mineral Deposit Reports 1-5 and compilations for published reports MDS 1, 2 and 3 and NTS area 63K/12 that is now in preparation.

PRODUCTS:

Diagrams and maps for inclusion in Mineral Deposit Series Reports.

FOLLOW-UP AND IMPLICATIONS:

The implementation of computer-based mineral deposit compilation will allow rapid updating and modification of mineral deposit series reports. Additionally, the autocad system will permit manipulation of geological, geochemical and geophysical characteristics of mineral occurrences from a selected area so that a regional metallogenetic overview can be obtained. In this way, future mineral deposit studies can be undertaken in areas of favourable geological environments.

EXPLORATION SERVICES (MINES BRANCH)

The Exploration Services Section continues to mount and support MDA initiatives in the areas of drill core retrieval, liaison with industry, and generating compilations of various types. The Department's publications distribution function has been transferred to the Information Office, Room 555 on the fifth floor of Eaton Place.

The principal objective set for the core retrieval program during 1987 was to establish a computer-based master inventory of the northern Manitoba drill library holdings. By September approximately 70% of the inventories from The Pas, Thompson and Lynn Lake had been entered into computer files.

Other projects conducted during the year included updating of inventories; field collection, reboxing and culling of core, and improvements to building site drainage.

One of the major new thrusts of the Section was the re-establishment in September, of the Regional Geologist in The Pas, a position, that fell dormant in 1977. David Prouse is welcomed to the position which will provide an elevated level of liaison and services to the mineral industry in northern Manitoba.

Exploration Services also continued to monitor and report on company activities in the Province as well as distributing large numbers of brochures and publications. Significant additions were made to the content and retrievability of the Bibliography of Manitoba Geology, as well as completing the updating of the mineral inventory for gold deposits/occurrences. Phase 2 of the Bibliography was printed as Open File Report OF88-1.

An Economic Geology report "Gold Deposits in Manitoba" (produced jointly with the Geological Services Branch) was released in November 1987.

Assessment files were completely re-organized and new index maps completed for airborne geophysical surveys. Displays and brochures were prepared for several major public events including: the annual Prospectors & Developers Convention; the Careers Symposium, and articles for various journals.

PROJECT 5.9: Bibliographies Progress Report

"Bibliography of Manitoba Geology (1795-1988)" (Bibliography Series BMG-1) is ready for printing and replaces Open File Reports OF86-1 and OF88-1. The bibliography database now contains 6733 references to provincial and federal publications, journal literature, theses and conference abstracts. Computerized searching by author, year, title, publication, subject keywords and NTS area is available through Exploration Services. During the year 132 searches were made by customers and staff. Plans are being made to extend this service to PC users via the DATAPAC network. Included in the Bibliography project is the building of an archive file of all geoscience documents on the Province. At present there are 3100 documents in the library with 550 being added in 1988-89.

"Gold Deposits of Manitoba" (Economic Geology Report ER86-1) was reprinted and a manuscript of a report on platinum deposits and occurrences was prepared. Mineral inventory cards for silver and pegmatites were updated and revision of base metal cards is underway. In all, 101 inventory cards were compiled or updated and 35 new files were added to the Corporation File. A computer index to mineral inventory cards was entered into dBase on the Section's PC. Twenty-one index maps, showing the outline of work described in assessment reports and maps were updated to December 1988 and five maps depicting government geoscience surveys were also revised. There were 45 separate users of the Inventory File and 26 of the historical Corporation File during the year.

Displays, pamphlets and brochures were prepared for the March, 1989, Prospectors and Developers Convention in Toronto, the November, 1988, Annual Meeting with Industry and the International Business and Investment Exposition in Vancouver also held in November, 1988. Careers Symposia in Winnipeg, Brandon, Flin Flon and The Pas were staffed by Section employees and others from the Department. The fourth annual meeting of the Mineral Exploration Liaison Committee was attended by two section staff in November, 1988, and the Head of the Section served as Manitoba's Co-Secretary to the Mineral Development Agreement Management Committee during the year.

PROJECT 307: Drill Core Libraries

The Precambrian diamond drill core storage and retrieval project had its major activity during the first three years of the Agreement. These last two years, with lesser staff and resources, have been a period of consolidation and maintenance of acceptable levels of public service. During the 1988-89 7440 metres of core were collected in 11 separate field retrievals and 5736 m were removed in the selective reduction program of high density drilling. Library improvements were completed in all buildings, in particular in Winnipeg where 200 feet of new racking was constructed with a 5100 box capacity and 4220 boxes (28 285 m) of core formerly stored in cross piles was placed in these racks. There were 15 inspection visits at the core libraries this year consisting of 29 man days of use. Geologists from 10 companies and the provincial and federal governments used the Libraries. Student help amounted to 16 man weeks and a rock saw was purchased and set up in The Pas Library. As of March 31, 1989, the Department's drill core inventory was 174 881 m stored in four regional facilities; Lynn Lake (44 328 m), Thompson (31 266 m), The Pas (69 924 m), and Winnipeg (29 363 m). A computerized core box labelling system is now used and a NTS manual file of logs and plans is maintained. A detailed computer-based index to all holdings is being prepared for release as an Open File. Advertising at the PDAC conventionand the Annual Manitoba Energy and Mines Meeting with Industry and, in annual Reports of Field Activities has served to increase industry awareness of this service.

IV. OUTPUTS - PUBLICATIONS, PRESENTATIONS, DISPLAYS, BROCHURES

MDA PUBLICATIONS AND TECHNICAL INFORMATION RELEASES: (principally MDA funded)*

MANITOBA:

i REPORTS:
- Departmental publications;
- Report of Field Activities;
- Preliminary Maps

ii UNPUBLISHED REPORTS:
- (on file in Manitoba Energy and Mines, Geological Services Branch)

iii EXTERNAL PUBLICATIONS

iv PRESENTATIONS:
- Manitoba Energy and Mines Annual Meeting
- Other

v FIELD DEMONSTRATIONS

CANADA

I REPORTS

Departmental Publications:

Baldwin, D.A.

1988: Geology of the southern part of the Rusty Lake volcanic belt; Geological Report GR86-1.

Bannatyne, B.B.

1988: Dolomite resources of Southern Manitoba; Economic Geology Report ER85-1.

Cameron, H.D.M.

1988: Geology of the Eden Lake area; Geological Report GR 84-2.

Canada-Manitoba Mineral Development Agreement 1984-89 (ERDA)

1988: Sector A Geoscientific Activities, Progress Report 1987-88; Open File Report OF88-2.

Chackowsky, L.E.

1988: Bibliography of Manitoba, Geology 2 (serial literature and thesis supplement to B.M.G.I.), Open File Report OF88-1.

Ferreira, K.J. and Fedikow, M.A.F.

1988: Preliminary results of a humus geochemical survey over the Rod Cu-Zn deposit, Snow Lake, Manitoba; Manitoba Energy and Mines Open File Report OF87-12.

Fedikow, M.A.F.

1988: The application of MEISS II and MSS remote sensing imagery to the Agassiz Metallotect, Lynn Lake; Remote Sensing in Manitoba Newsletter, January.

Fedikow, M.A.F.

1988: Gold in Manitoba, Mineral Education Series, Manitoba Energy and Mines.

Fogwill, W.D. and Bamburak, J.D.

1988: Mining in Manitoba; Mineral Education Series.

Gale, G.H. and Eccles, D.R.

1988: Mineral Deposits and Occurrences in the Flin Flon area, NTS 63K/13: Part I, Mikanagan Lake Area, (63K/13 SE); Manitoba Energy and Mines, Geological Services, Mineral Deposit Series, Report No. 1.

Gale, G.H. and Eccles, D.R.

1988: Mineral Deposits and Occurrences in the Flin Flon area, NTS 63K/13: Part II, Flin Flon Area, (63K/13 SW); Manitoba Energy and Mines, Geological Services, Mineral Deposit Series, Report No. 2.

Gale, G.H. and Eccles, D.R.

1988: Mineral Deposits and Occurrences in the Flin Flon area, NTS 63K/13: Part III, Weasel Bay (63K/13 NW) and Defender Lake (63K/13 NE); Manitoba Energy and Mines, Geological Services, Mineral Deposit Series, Report No. 3.

Gale, G.H. and Ferreira, K.J.

1988: Geological setting of the Tartan Lake gold deposit; Manitoba Energy and Mines, Economic Geology Report ER87-1.

Hosain, I.

1988: An update summary and evaluation of the geophysical data from the open assessment files of the Flin Flon-Snow Lake greenstone belt; Manitoba Energy and Mines, Open File Report OF87-11.

Leskiw, P.D.

1988: Bibliography of Manitoba Geology 1, Open File Report OF86-1.

Manitoba Energy and Mines, Minerals Division

1988: Report of Field Activities 1988.

Manitoba Energy and Mines, Geological Services

1988: Oxford House - NTS 53L, 1:250 000 with marginal notes; Bedrock Geology Compilation Map 53L.

Manitoba Energy and Mines, Geological Services

1988: Herchmer - NTS 54E; 1:250 000 with marginal notes; Bedrock Geology Compilation Map 54E.

* Some projects were initiated under the Interim Mineral Agreement

Manitoba Energy and Mines

1988: Northern Indian Lake - NTS 64H, 1:250 000 with marginal notes; Bedrock Geology Compilation Map 64H.

Manitoba Energy and Mines

1988: Kississing - NTS 63N, 1:250 000 with marginal notes; Bedrock Geology Compilation Map 63N.

Nielsen, E.

1988: Surficial geology of the Swan River area; Manitoba Energy and Mines, Geological Report GR80-7.

Richardson, D.J. and Ostry, G.

1987: Gold Deposits of Manitoba; Manitoba Department of Energy and Mines, Economic Geology Report ER86-1; 91 p. (reprinted).

Singh, V., Moon, W.M. and Fedikow, M.A.F.

1988: An integrated remote sensing study of mineralized zones associated with the Agassiz Metallotect, Lynn Lake, Manitoba (I) MEIS-II and biogeochemical study; Manitoba Energy and Mines, Open File Report OF88-3, GSC OF-1994.

Report of Field Activities:

Introductory review; by W.D. McRitchie

LYNN LAKE DISTRICT

GS-1 Alkaline intrusions of the Churchill Province: Eden Lake (64C/9) and Brezden Lake (64C/4); by W.D. McRitchie

GS-2 Investigation of volcanic stratigraphy and iron formation occurrences, Lynn Lake area; by D. Parbery

GS-3 Preliminary observations of a detailed geological investigation of the Gemmell Lake area, Lynn Lake; by G.R. Sherman, I.M. Samson and P.E. Holm

FLIN FLON DISTRICT

GS-4 Athapapuskow Lake Project; by E.C. Syme

GS-5 Geological investigations in the Tartan Lake-Embury Lake area; by H.P. Gilbert

GS-6 Kisseynew Project: Geology of the Kississing Lake area; by D.C.P. Schledewitz

GS-7 Kisseynew Project: Batty Lake region; by H.V. Zwanzig

GS-8 Chisel-Morgan Lakes Project; by A.H. Bailes

GS-9 Project Cormorant: Sub-Paleozoic investigations south of Flin Flon and Snow Lake; by W. Weber

GS-10 U-Pb zircon geochronology of the Richard Lake tonalite, a possible synvolcanic pluton in the Flon Flon belt; by A.H. Bailes, T.M. Gordon and P.A. Hunt

GS-11 Geological setting of the Big Island zinc property, Shore Lake area, Flin Flon; by K. Ferreira and G.H. Gale

GS-12 Geology of the Leo Lake area; by K. Ferreira

GS-13 Geological setting of the Baker Patton alteration zone by G.H. Gale and G. Foote

GS-14 Mineral investigations in the Kisseynew gneiss terrain; by G. Ostry

GS-15 Mineral occurrence documentation - Herblet and Pulver gneiss domes and Wekusko Lake area; by M.A.F. Fedikow and G. Malis

GS-16 Microprobe analysis of pyroxenes in the Amisk Group, Flin Flon; by A.C. Turnock and E.C. Syme

GS-17 Industrial Mineral occurrences in the Flin Flon and Thompson areas; by W.R. Gunter

SOUTHEAST MANITOBA DISTRICT

GS-18 Geological investigations in the Rice Lake area; by W. Weber

GS-19 Industrial Mineral investigations in southeast Manitoba; by B.E. Schmidtke

THOMPSON - CROSS LAKE DISTRICT

GS-20 Cross Lake geological investigations; by M.T. Corkery, P.G. Lenton, M. Breedveld and D.W. Davis

GS-21 Thompson nickel belt project: Pipe Pit Mine (part of 63-O/8NE); by W. Bleeker and J.J. Macek

GS-22 Tectonic setting of Circum-Superior ultramafic and mafic volcanism in Manitoba; by N.M. Halden

GS-23 U-Pb geochronology program: Thompson belt and northwest Superior Province; by N. Machado, L. Heaman and W. Weber

NORTHWEST SUPERIOR DISTRICT

GS-24 Petalite leucogranite at Red Sucker Lake; by R.E. Meintzer, P. Cerny and H. Odwar

MANITOBA GENERAL

GS-26 Stratigraphic mapping and core hole program; by H.R. McCabe

GS-27 Silurian stratigraphy of the Interlake area; by G.E. Lammers

GS-28 Karst investigations in Paleozoic carbonates of the Grand Rapids Uplands and Southern Interlake; by G. Sweet, P. Voltovici and W.D. McRitchie

GS-29 Subsurface Precambrian geology of The Pas-Grand Rapids area; by C.R. McGregor

GS-30 Platinum Group Element investigations; by P. Theyer

GS-31 Till geochemistry in northwest Manitoba; by E. Nielsen and G. Gobert

Preliminary Maps:

1988F-1 Schist Lake (Part of 63K/12); by E.C. Syme (Supersedes 1987F-1)

1988F-2 Bakers Narrows (Part of 63K/12); by E.C. Syme (Supersedes 1987F-2)

1988F-3 West Arm (Part of 63K/12); by E.C. Syme

1988F-4 Millwater (Part of 63K/12); by E.C. Syme

1988F-5 Tartan Lake-Embury Lake (Part of 63K/13); by H.P. Gilbert (Supersedes 1987F-3)

1988K-1 Kississing Lake (63N/3); by D.C.P. Schledewitz

1988K-2 Batty Lake (63N/2 and part of 63N/1); by H.V. Zwanzig, P.G. Lenton, B.S. Miller, P. Elias and G. Arkos (Supersedes 1987K-3)

1988S-1 Chisel-Morgan Lakes (Part of 63K/16); by A.H. Bailes (Supersedes 1987S-1)

1988T-1 to T-8 Pipe Open Pit Mine (Part of 63-O/8NE); by W. Bleeker and J.J. Macek

II UNPUBLISHED REPORTS

(on file with Manitoba Energy and Mines, Geological Services Branch)

Conley, G. and McRitchie, W.D.

1988: Toward a Provincial mineral oriented Geographic Information System (GIS) in Manitoba, December 1988.

Lammers, R.

1988: Silurian lithological units of the Interlake Region of Manitoba. Final Report.

Machado, M., Heaman, L., Davis, D.W., Krogh, T. and Weber, W.

In press: Progress report on U-Pb geochronology of the Thompson belt - northern Superior Province in Manitoba, 7 p.

Schledewitz, D.C.P.

1988: Evaluation of the mineral potential of the Seal River Region (from Big Sand Lake to Hudson Bay).

Schmidtke, B.E.

1988: The Tie Creek Land Use Conflict - a Geological Perspective; Manitoba Energy and Mines, 29 p.

1988: Dimension stone potential of the Tie Creek Basin; Manitoba Energy and Mines (internal report).

III EXTERNAL PUBLICATIONS

Baldwin, D.A.

1989: Hot formed accretionary lapilli in a Proterozoic subaerial felsic volcanic sequence, Rusty Lake greenstone belt, northern Manitoba; Geological Association of Canada, Program with Abstracts (in press).

Blair, B., Weber, W., Kornick, L.. and Gordon, T.M.

1988: Sub-Paleozoic geology of the Cormorant Lake map area interpreted from geophysical and drill core data; Geoscience Canada, v. 15, no. 2, p. 98-100.

Clark, G.S. and Schledewitz, D.C.P.

1988: Rubidium-strontium ages of Archean and Proterozoic rocks in the Nejanilini and Great Island domains, Churchill Province, northern Manitoba, Canada, Canadian Journal of Earth Sciences, v. 25, p. 246-254.

Dixon, R. and Stewart, J.

1988: Peatland inventory of Manitoba III, Interlake Region (using Landsat 5/Thematic mapper); Manitoba Natural Resources, Surveys and Mapping Branch.

Dredge, L., Morgan, A.V. and Nielsen, E.

In press: Sangamon and pre-Sangamon interglaciations in the Hudson Bay Lowland of Manitoba; Geographie Physique et Quaternaire.

Ferreira, K.J. and Fedikow, M.A.F.

1989: Specific conductance and hydrogen ion concentration as indicators of trace element geochemical response in humus: Rod Cu-Zn and Big Island Zn-Cu-Zu deposits, Manitoba (Canada); Journal of Geochemical Exploration (in prep.).

Gale, G.H., McCabe, H.R. and Nielsen, E.

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Gunter, R.

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Halden, N.M., Clark, G.S., Corkery, M.T., Lenton, P.G. and Schledewitz, D.C.P.

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Theyer, P.

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Weber, W. and Mezger, K.

In prep.: An oblique cross section of Archean continental crust at the northwestern margin of the Superior Province, Manitoba; Canada, NATO workshop on Exposed Cross-Sections of Continental Crust, special volume.

Iv PRESENTATIONS

Manitoba Energy and Mines Annual Meeting with Industry, November 21, 1988:

Review of Activities: W.D. McRitchie

Highlights of Minerals Investigations; G.H. Gale

Highlights of Provincial Geological Mapping; W. Weber

Stratigraphic mapping and core hole program: a 1988 perspective; H.R. McCabe

Quaternary geology and drift prospecting in eastern Manitoba; E. Nielsen

Stratigraphy, and mineralization of the Agassiz metallotect; D. Parbery and M.A.F. Fedikow

Geology of the Athapapuskow Lake area; E.C. Syme

Supracrustal rocks, Thompson Nickel Belt; J.J. Macek

(H+) and specific conductance in soil geochemical surveys; M.A.F. Fedikow and K. Ferreira

Dimension stone potential in S.E. Manitoba; new architectural applications; B.E. Schmidtke

Other Presentations:

An oblique cross-section of Archean continental crust at the northwestern margin of the Superior Province, Manitoba, Canada; by W. Weber and K. Mezger at NATO workshop on "Exposed non-section of continental crust" Killarney, Ontario, Canada.

Silicification, Fe-Mg metasomatism, base metal mineralization and synvolcanic plutonism, Snow Lake, Manitoba; by A.H. Bailes at Brandon University, Brandon, Manitoba.

Surficial geology and overburden geochemistry southeast Manitoba; by E. Nielsen, G. Gobert and G. Matile, at Minnesota Geological Survey Open House, Hibbing, Minnesota.

Till stratigraphy and geochemistry, Nelson River, Manitoba - a review of ongoing work; by E. Nielsen at Geological Survey of Canada (invited paper).

Geological Services Branch Geoscience Information System; by G. Conley at Workshop on GSIS (Geoscience Information System), National Geological Survey Committee, Ottawa, Ontario.

An Overview of Industrial Minerals in Manitoba; by R. Gunter, at CIM Annual Meeting, Edmonton (May, 1988).

Exploration directed activities of the Manitoba Energy and Mines Geological Services Branch; by G.H. Gale, at Prospectors and Developers Association Annual Meeting, Toronto (March, 1989).

Geological setting of the Tartan Lake gold deposit; by G. Gale, at CIM [Local], Flin Flon (May, 1988).

Industrial Mineral Occurrences in Manitoba; by R. Gunter, at University of Manitoba (March, 1989)

Industrial Minerals Exploration Techniques; by R. Gunter, at CIM [Local], Flin Flon (February, 1989); at CIM [Local], Lynn Lake (February, 1989).

Industrial Minerals in Manitoba; by B.E. Schmidtke, at Meeting of Provincial Industrial Mineral Specialists, Ottawa (October, 1988).

PGE concentration environments and exploration guidelines; by P. Theyer, at University of Manitoba (March, 1989).

Regional metallogeny and exploration geochemistry; by M.A.F. Fedikow, at University of Manitoba (January, 1989).

Selected mineral collecting localities in Manitoba; by R. Gunter, at Manitoba Rock and Gem Club, Winnipeg (March, 1989).

Successful and unsuccessful applications of vegetation geochemical surveys in Manitoba; by M.A.F. Fedikow, at CIM [Local], Winnipeg (April, 1988).

Volcanic products, processes and the depositonal environment of volcanic rocks in Karsakuwigamak Block, Rusty Lake greenstone belt; an example of stratigraphic analysis; by D.A. Baldwin, at CIM [Local], Flin Flon (March, 1989); at CIM [Local], Lynn Lake (March, 1989).

Devonian reef configurations and Manitoba's Paleozoic stratigraphy. Display given at America Association of Petroleum Geologists (AAPG) regional meeting in Bismark, North Dakota by H.R. McCabe.

v FIELD DEMONSTRATIONS

Balles, A.H.: 2-day field demonstration in Cook and Chisel Lake area for industry geologists.

Baldwin, D.A., Fedikow, M.A.F., Ferreira, K.J., Gale, G.H., Gilbert, H.P., Ostry, G. and Syme, E.C.: Field demonstrations of the geology at Big Island Zn deposit with geologists of Westfield Minerals Ltd., June 1988.

Corkery, T.M.: Overview of the geology of the Nelson River between Birthday Rapids and Gull Rapids for Manitoba Hydro.

Corkery, M.T. and Lenton, P.G.: Field trip demonstrations of the Structure of the Cross Lake belt I for Federal Government geologists.

Corkery, M.T. and Lenton, P.G.: Field trip demonstrations of the Structure of the Cross Lake belt II for Federal Government geologists.

Fedikow, M.A.F.: Field demonstration of the Watts Creek gold occurrence for J. Corman (prospector), July, 1988.

Fedikow, M.A.F.: Field demonstration of the Yukon Lake alteration zone for geologist from Pro Roc Explorations Inc., July, 1988.

Gale, G.H. and Ferreira, K.J.: Field demonstrations of geology at the Big Island Zn deposit for geologists from Westfield Minerals Ltd., July and August, 1988.

Macek, J.: Field demonstration of geology of the Thompson belt for Friends of the Nickel Belt, Thompson, Manitoba.

Macek, J.: Field demonstration of the geology at the Pipe Mine open pit at Thompson, Manitoba for INCO geologists.

Macek, J.: Field demonstration of the geology of the Ospwagon Group at Thompson, Manitoba with INCO geologists and geoscientists from universities and Federal Government.

McCabe, H.R. and Lammers, G.: Field demonstration of Silurian and Ordovician Stratigraphy, Grand Rapids area for the Speleological Society of Manitoba (May, 1988).

McCabe, H.R.: Co-leader of 3-day field trip into Manitoba's Ordovician, Silurian and Devonian as part of regional AAPG meeting in Bismarck, North Dakota.

Ostry, G.: Field demonstrations of geology in the Puffy Lake area for geologists from Pioneer Metals Corporation, GSC, University of Manitoba and University of Brandon, June and July, 1988.

Theyer, P.: Field demonstration of Bird River Complex chromite exposure for P. Laznicka (University of Manitoba), June, 1988.

Zwanzig, H.V. and Schledewitz, D.C.P.: Field demonstrations in Kisseynew gneisses of Saskatchewan and Manitoba.

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1988: Surficial Geology, Stull Lake, Manitoba Ontario (1:250 000 scale); Geological Survey of Canada, Map 1672A.

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Eckstrand, O.R., Grinenko, L.N., Krouse, H.R., Paktunc, A.D., Schwann, P.L. and Scoates, R.F.J.

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Schmitt, H.R.

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1989: Semiconformable hydrothermal alteration below the Chisel Lake Zn-Cu massive sulphide deposit, Snow Lake, Manitoba; Geological Survey of Canada, Open File 1986, 2 maps with descriptive notes.

High Resolution Aeromagnetic Total Field and Vertical Gradiometer Surveys of:

The Hargrave River and Bissett areas, Manitoba; 28 maps (1:20 000 scale)

The Hanson Lake, Amisk Lake, Namew Lake areas, Saskatchewan, and Root Lake, Moose Lake, Elbow Lake areas in Manitoba; 138 maps (1:20 000 scale).

The Hargrave River, Moose Lake and Bissett areas, Manitoba; 16 maps (1:50 000 scale).

High Resolution Aeromagnetic Total Field and Time Domain Electromagnetic Surveys of the MacMillan Lake, Suttie Lake and Zed Lake areas west of Lynn Lake, Manitoba; 14 maps (1:20 000 scale).

MANITOBA REPORT OF FIELD ACTIVITIES:

GSC-1 Metamorphosed alteration zones (Project C.1.1.1); by L. Froese

GSC-2 Geochronology in the Churchill Province (Project C.1.1.3); by T.M. Gordon

GSC-3 Project Cormorant: Interpretation of sub-Paleozoic geology south of Flin Flon-Snow Lake (Project C.1.2.1)

GSC-4 Flin Flon-Snow Lake metallogeny (Project C.2.1.1); by A.G. Galley

GSC-5 Structural and alteration studies, Bissett area (Project C.2.1.2); by K.H. Poulsen

GSC-6 Agassiz remote sensing (Project C.7.1.3); by A.N. Rencz

GSC-7 Metallogeny of mafic-ultramafic rocks, Flin Flon-Snow Lake (Project C.2.2.1); R.F.J. Scoates

GSC-8 Metallogeny of mafic-ultramafic rocks, northern Churchill (Project C.2.2.2); by L.J. Hulbert

GSC-9 Metallogeny of mafic-ultamafic rocks, Falcon Lake igneous complex (Project C.2.2.3); by P.A. Tirschmann and N.M. Halden

GSC-10 Metallogeny of mafic-ultramafic rocks, Fox River sill (Project C.2.2.4); by P.L. Schwann and R.F.J. Scoates

GSC-11 Metallogeny of mafic-ultramafic rocks, Bird River (Project C.2.2.5); by R.F.J. Scoates

GSC-12 Metallogeny of mafic-ultramafic rocks, Thompson belt (Project C..2.2.6); by O.R. Eckstrand

GSC-13 Aeromagnetic Gradiometer/VLF and EM surveys (Project C.3.1.1); by E.E. Ready

GSC-14 Geochemical surveys (Project C.4.1.1); by R. Schmitt and P.W.B. Friske

GSC-15 Drift prospecting: northwestern Manitoba (Project C.4.1.2); by C.A. Kaszycki

GSC-16 Surficial geology atlas compilation, Manitoba north of 52° (Project C.5.1.1); by M.D. Clarke

GSC-17 Alteration zones, structure, and metamorphism of the Laurie Lake area (Project C.1.1.2); by S.L. Jackson

GSC-18 Could the Sherridon Group at Sherridon be a high grade equivalent of the Amisk Group?; by K.E. Ashton and C. Froese

EXTERNAL PUBLICATIONS:

Bleeker, W.

in press: Structure of the Thompson Nickel Belt; in Geology of the Early Proterozoic Trans-Hudson Orogen, Geological Association of Canada, Special Volume.

Gordon, T.M. et al

in press: U/Pb age dating of the Churchill Province; in Geology of the Early Proterozoic Trans-Hudson Orogen, Geological Associaton of Canada, Special Volume.

Hegner, E., Kyser, T.K. and Hulbert, L.J.

in press: Nd, Sr and O isotopic constraints on the petrogenesis of mafic intrusions in the Proterozoic Trans-Hudson Orogen of central Canada; Canadian Journal of Earth Science.

Jackson, S.L.

in press: Alteration zones, structure and metamorphism of the Laurie Lake area, Manitoba; Canadian Jornal of Earth Science.

Kaszycki, C.A.

1988: Late Wisconsinan ice flow history, northwestern Manitoba; in Geological Association of Canada Mineralogical Association of Canada, Program with Abstracts, Volume 13, p. A64.

Machado, N. et al

in press: U/Pb age dating of the Thompson Belt; in Geology of the Early Proterozoic Trans-Hudson Orogen, Geological Association of Canada, Special Paper.

Mandziuk, W., Brisbin, W.C. and Scoates, R.F.J.

in press: Igneous structures in the Falcon Lake intrusive complex; Mineralogical Association of Canada Bulletin.

Schwann, P.L. and Scoates, R.F.J.

1988: Petrology of Platinum Group Element mineralized units, upper central layered zone, Fox River Sill, northeastern Manitoba; in Geological Association of Canada Mineralogical Association of Canada, Program with Abstracts, Volume 13, p. A 110.

Zaleski, E.

1988: Relationships between deformation and metamorphism at the Linda volcanogenic massive sulphide deposit, Snow Lake, Manitoba; in Geological Association of Canada Mineralogical Association of Canada, Program with Abstracts, Volume 13, p. A138.

PRESENTATIONS:

Manitoba Energy and Mines Annual Meeting with Industry, November 1988:

Could the Sherridon Group at Sherridon be a high-grade equivalent of the Amisk Group?; K.E. Ashton

Review of the Geological Survey of Canada's MDA Program in Manitoba; A.G. Galley

Drift prospecting in northwesten Manitoba; C.A. Kaszycki

Other Presentations:

Worskhop on metamorphism at the University of Manitoba, September, 1989; E. Froese

Some aspects of gold metallogeny in the Southern Churchill Province, at CIM Flin Flon and Lynn Lake (February, 1989), CIM Saskatoon (April, 1989) and at the Manitoba Geological Services Branch (February, 1989);A.G. Galley

Wokshop on metamorphism at University of Manitoba, September, 1989; T.M. Gordon

POSTER DISPLAYS:

Manitoba Energy and Mines Annual Meeting with Industry, November 1988:

Zonation of wallrock alteration at the San Antonio Mine, Bissett, Manitoba; D.E. Ames

Geology of the Pipe No. 2 open pit, Thompson, Manitoba; W. Bleeker and J.J. Macek

Structural setting of the Gunnar Mine, Beresford Lake, Manitoba; R. Brommecker and K.H. Poulsen

Surficial geology compilation north of 52°; M.D. Clarke

Project Cormorant: Interpretation of sub-Paleozoic geology; J. Dugal

Geology of the Chisel Lake open pit, Snow Lake, Manitoba; A.G. Galley and A.H. Bailes

Drift prospecting in northwestern Manitoba; C.A. Kaszycki

Distribution of gold in lake sediments and surficial deposits, Foster Lake, Manitoba; R. Schmitt

OTHER MEETINGS:

Drift prospecting in northwestern Manitoba; at the 1989 GSC Current Activities Forum; C.A. Kaszycki

Gold mobilization in lake sediments; at the Prospecting in Areas of Glaciated Terrain Conference, Halifax, September 1988; R. Schmitt

FIELD DEMONSTRATIONS:

Tour of the geology of the Chisel Lake open pit for Hudson's Bay Mining and Exploration geologists; A.G. Galley

Tour of the geology and gold deposits of the Rice Lake Belt for geologists from the national survey, Republic of China; K.H. Poulsen et al

V. GEOLOGICAL SURVEYS AND MINERAL INVESTIGATIONS
1989-90 PROVINCIAL WORKPLAN

The joint Federal-Provincial Workplan covering Sector 'A' Geoscientific activities scheduled for 1989/90 was reviewed and approved by the MDA Management Committee at its 12th meeting, in Ottawa, March 14, 1989. In the absence of Federal endorsement for a second five year agreement, the Province also tabled its intention to initiate a maintenance level of new field projects that would sustain surveys and investigations at a more or less normal level, thereby providing a nucleus for expanded programming in future years.

During 1989/90 the major Sector 'A' thrust will be to complete technical reports and maps stemming from the previous five years of Canada-Manitoba MDA field surveys and investigations.

Most reports will focus on the Lynn Lake-Ruttan and Flin Flon-Snow Lake regions; these being the principal targets of MDA initiatives during the period 1984-89. Other publications will include: an evaluation of industrial mineral resources in northern Manitoba, building stone potential in southeast Manitoba; mapping projects in the southeast Manitoba, Thompson and Cross Lake regions; and additional reports in the Mineral Deposit Series documenting significant mineral occurrences in the Province. Several new map sheets will be issued in the 1:250 000 bedrock compilation series.

Preparation of reports will entail extensive computer analysis of multiple data sets generated by the Federal and Provincial Geological Surveys, as well as large numbers of rock and mineral analyses to aid definition of geochemical anomalies, and areas favourable for mineralization.

The emphasis on report production will also incur a need to sustain support-cartographic staffing and term personnel at existing levels.

Field surveys will be kept to a minimum and will mainly entail new pilot and reconnaissance projects preparing the ground for the next five year cycle of initiatives.

Operational budgets for Provincial programming will total $757K.

Project locations are illustrated in Figure 13.

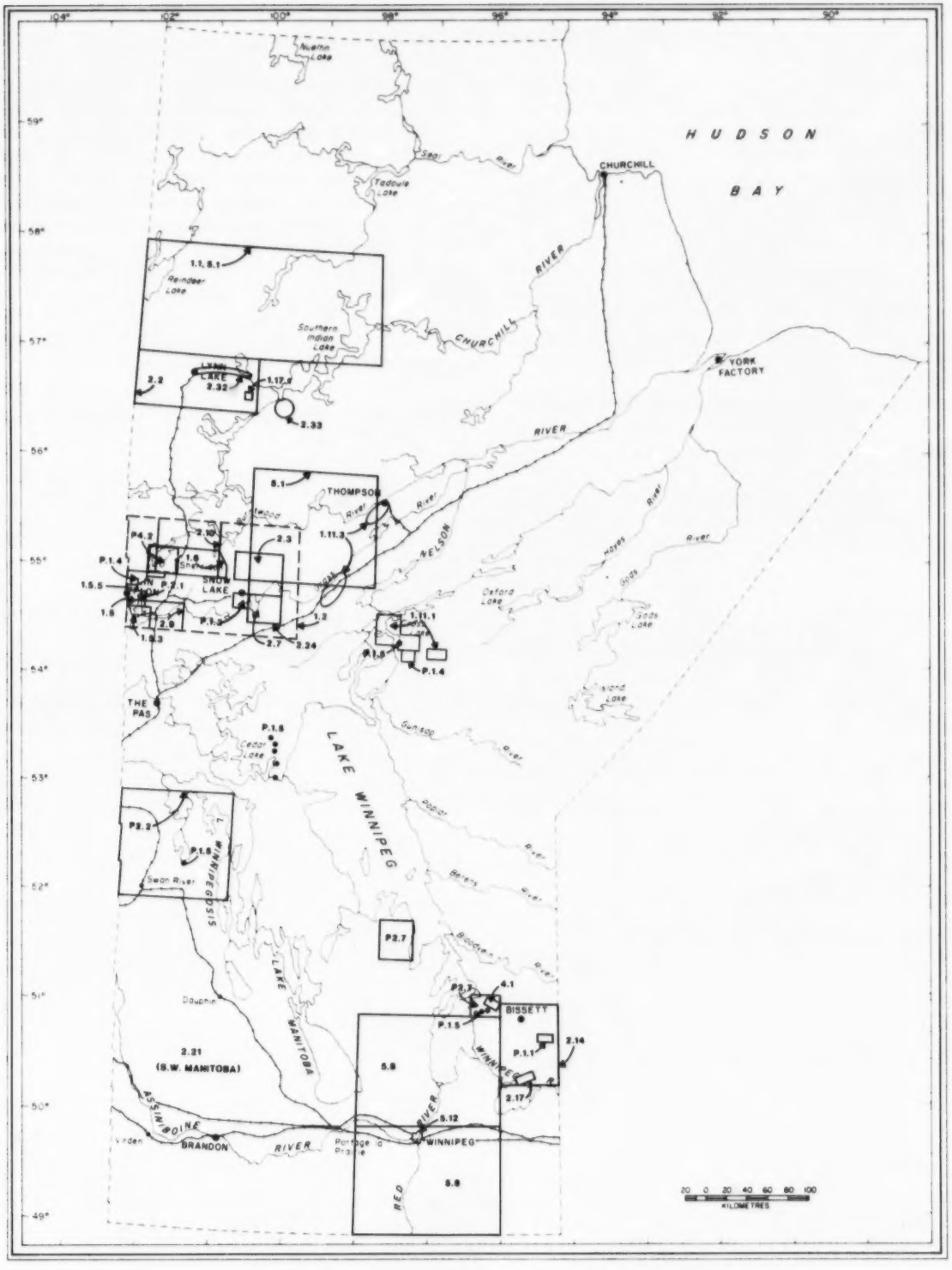

Figure 13: Location of Provincial Projects 1989.

Project Listing (Manitoba)

MDA Sector A
1989/90

Survey Programs			Total $
1.1	Geological mapping, Big Sand-Brochet area	D.C. Schledewitz	-
1.2	Uranium-lead isotope, Flin Flon	A.H. Bailes/E.C.Syme	12.0
1.5	1:20 mapping, Flin Flon-White Lake	A.H. Bailes/E.C.Syme	-
1.5	1:20 mapping, Athapapuskow	E.C. Syme	8.5
1.5.5	Tartan Lake; 1:20 mapping	H.P. Gilbert	6.0
1.6	Kisseynew south flank	H.V. Zwanzig/D.C.P. Schledewitz	9.0
1.11.1	Thompson and Pipe Pit mapping	J. Macek	12.0
1.15	Project management	W. Weber	2.0
1.17.1	Alkaline intrusions	W.D. McRitchie	6.0
	Sub Total		55.0
Mineral Investigations			
2.2	Lynn Lake, Johnson Shear	D.A. Baldwin/Vacant	27.5
2.7	Snow Lake gold deposits	M.A.F. Fedikow	14.0
2.9	Occurrence documentation, Flin Flon	G.H. Gale	30.0
2.10	Occurrence documentation, Kisseynew	G.M. Ostry	5.0
2.14	Occurrence documentation, Rice Lake	P. Theyer	22.0
2.17	PGE potential	P. Theyer	3.0
2.21	Pb/Zn - Paleozoic	G.H. Gale/W.D. McRitchie	10.0
2.24	Snow Lake compilation	M.A.F. Fedikow	21.0
2.32	Lynn Lake iron formations	D. Parbery/M.A.F. Fedikow	22.0
2.33	Deposit Geology, Ruttan	D.A. Baldwin/Vacant	1.0
	Sub Total		155.5
Quaternary Investigation			
4.1	Basal till investigations	E. Nielsen	10.0
	Sub Total		10.0
Compilation			
5.1	Bedrock Atlas compilation	D.C.P. Schledewitz/D.E. Lindal et al.	30.0
5.8	Paleozoic compilation	W. Weber/C. McGregor/R. Bezys	5.0
5.9	Bibliographies	W.D. Fogwill	67.0
5.12	Mineral deposit compilation	R. Eccles/G.H. Gale	54.0
	Sub Total		156.0
	Overall Total		377.7

'A' Base Operations

Geological Surveys			Total $
P 1.1	Manigotagan mapping	W. Weber	10.0
P 1.2	Chisel/Anderson	A.H. Bailes	30.0
P 1.3	Florence Lake	K.E. Ashton	45.0
P 1.4	Nelson River East	H.D.M. Cameron	11.0
P 1.5	Scout drilling	D. Berk	24.5
P 1.6	Computerization	G. Conley	34.0
	Sub Total		154.5
Minerals Investigations			
P 2.1	Deposit Geology, Flin Flon	G.H. Gale	20.1
P 2.2	Industrial minerals mapping	R. Gunter	17.0
P 2.3	Snow Lake gneiss domes	M.A.F. Fedikow	28.0
P 2.4	Deposit Geology, Lynn Lake	K. Ferreira	13.5
P 2.5	Kisseynew metallogeny	G.M. Ostry	27.0
P 2.6	Computerization	R. Eccles	18.0
P 2.7	Industrial Minerals, Southern Manitoba	B.E. Schmidtke	55.0
	Sub Total		178.6
Quaternary			
P 4.2	Basal till geochemistry	E. Nielsen	46.3
	Sub Total		46.3
	Overall Total		379.4

MINERALS DIVISION STAFF *

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Area Code: 204

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Secretary	L McClintock	945-6868

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	G. Tate	945-8832

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	P.G. Lenton	945-6553
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	D.C.P. Schledewitz	945-6566
	E. Syme	945-6556
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	M.A.F. Fedikow (Dr.)	945-6562
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	G. Ostry	945-6564
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	D. Parbery	945-4208
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	L. Ghobrial	945-6592
	L. Nguyen	945-6593

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Publications	H. Wilkie	945-6541
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Mineral Inventory Geologist	P. Athayde	945-0731
Compilation Geologist	L. Chackowsky	945-8204

MDA-AFFILIATED PERSONNEL FROM OTHER ORGANIZATIONS

GEOLOGICAL SURVEY OF CANADA

Ottawa — Area Code 613

D. Ames	992-9754
L. Ashton	546-2073
R.N.W. DiLabio	992-1380
L. Dredge	992-0630
J.M. Duke	996-9223
O.R. Eckstrand	992-7255
J. Franklin	995-4137
P. Friske	992-1503
E. Froese	995-4137
A. Galley	992-7867
E.H.W. Hornbrook	992-6559
L.J. Hulbert	992-7216
C.A. Kaszycki	992-5867
L. Kornik	995-4841
J. McGlynn	995-4314
K.H. Poulsen	992-2396
E. Ready	996-3338
A. Rencz	995-4786
R.F.J. Scoates	996-4628
C. van Staal	995-4333
B.L. Williamson	992-8563

Calgary — Area Code 403

T.M. Gordon	284-0396

UNIVERSITIES

Manitoba — Area Code 204

L.D. Ayres	474-8862
P. Cerny	474-8765
G.S. Clark	474-9454
W.C. Brisbin	474-9454
N.M. Halden	474-8861
F.C. Hawthorne	474-8861
S. Lau	474-8395
P. Laznicka	474-8765
M. Leroux	474-8395
D. Seneshen	474-8395
A.C. Turnock	474-9270
J. Young	474-8395
E. Zaleski	474-8395

Windsor — Area Code 519

A. Turek	253-4232
	253-2498

Toronto — Area Code 416

F. Fueten	828-5401

New Brunswick — Area Code 506

W. Bleeker	453-4804

Royal Ontario Museum — Area Code 416

T. Krogh	586-5811

Kansas

R. Van Schmus	864-3675

*Involved in delivery of Sector A activities.